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ORIGINAL ARTICLES

ORIGINAL RESEARCH ON THE PRECIOUS METALS USED IN ORTHODONTIA*

BY REGINALD V. WILLIAMS, A.C., BUFFALO, N. Y.

BEFORE going into this subject, it seems logical to explain why additional research or continued research is necessary to fill the highly specialized requirements of the orthodontist better.

During the past several years orthodontic materials have shown improvement. This improvement has come about not only through a better understanding of the orthodontic problems but also through an improvement in manufacturing methods.

An investigation in cooperation with Dr. Pullen, Dr. Ellis, Dr. Mershon and others has disclosed the fact that further study is called for and improvement may still be effected. Breakages occur in the lingual arch and labial arch and elsewhere, and this annoyance can most certainly be lessened.

Major reasons for arch failure may be enumerated as follows:

1. Using wires of exceptionally high tensile strength and low ductility.
2. The hardening heat treatment, either deliberately performed or as a result of soldering.
3. Excess of heat in soldering operations.
4. Hot manipulation of the arch wire.
5. Fatigue through manipulation by the patient.
6. Defective materials.

In the preliminary investigation of orthodontic materials carried out a number of years ago, it was found that, as a whole, ultimate tensile strengths were comparatively low. It was also found that either by change of formula

*Read at the Thirtieth Annual Meeting of the American Society of Orthodontists, St. Louis, Mo., April 20-24, 1931.

or by prescribed heat treatment, tensile strengths could be increased enormously, sometimes to the extent of 75 or 80 per cent. Investigators were quick to announce their discoveries to the profession. They also not only increased the tensile strength of their wires but showed the orthodontist how to effect even further increases through certain heat treatments. In some instances, heat treating equipment was manufactured or recommended for this purpose. Data were also published showing tremendously increased "life value" of hardened, heat treated wire.

An investigation in cooperation with the originator of the lingual arch, has disclosed the fact that exceptional hardness or high tensile strength is not desirable. Too rapid movement of the teeth is detrimental to the tissue. It was also amazing to note just how much could be accomplished through the gentle pressure of a tiny auxiliary spring. Exceptionally hard wires of

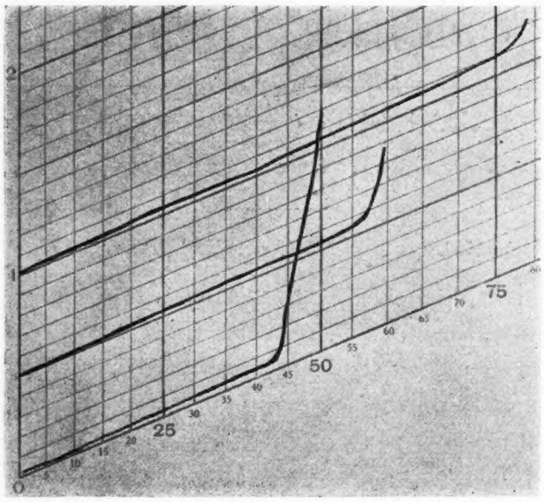


Fig. 1.—Stress-strain diagram of typical orthodontic wire in its quenched, air cooled and oven cooled condition. Its physical properties are as follows:

	Fusion Temperature Degrees F.	Tensile Strength Lb. per Sq. In.	Proportional Limit Lb. per Sq. In.	Elongation Percentage
Quenched	1990	114,500	76,200	21
Air cooled		143,500	113,500	8
Oven cooled		164,500	136,400	3

The extreme or oven cooled heat treatment shows greatly increased tensile strength but as judged by percentage of elongation, greatly decreased ductility.

high tensile strength and low ductility were apparently not only physiologically incorrect but metallurgically or mechanically hazardous. Wires of high tensile strength and low ductility can be subjected to permanent bends or repeated stresses only at the great risk of complete fracture. A close practical study of the orthodontist's technic will reveal the fact that a hardening heat treatment is not the cure for breakage evils, but in fact, might well be the cause.

It seems logical that materials should be furnished by the manufacturer in their softest annealed condition, yet in this condition, they should fulfill all orthodontic requirements. No matter what technic is employed by the operator, no matter how often he heats the appliance and chills immediately in

water or acid pickling solution, it should function properly. Air cooling of the heated appliance will of course add to the hardness and tensile strength and detract from the ductility, but if this procedure is more convenient for the orthodontist, the material should be capable of withstanding it. Oven cooling over a prolonged period is not only inconvenient but even dangerous.

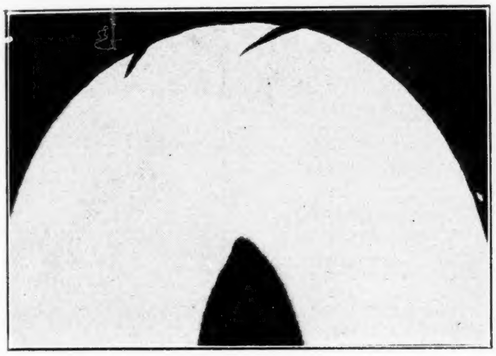


Fig. 2.

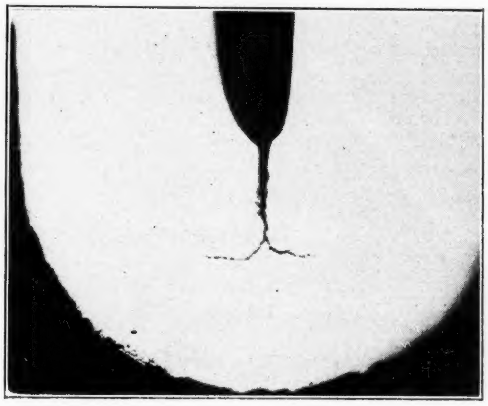


Fig. 3.

Fig. 2.—A fracture of the arch wire not visible to the naked eye, on the extreme outer edge of a rather sharp bend. Unetched view (×50).

Fig. 3.—Another fracture not visible under ordinary conditions on the extreme inner edge of a sharp bend. This fracture and the previous one are the result of bending after insufficient annealing, or bending after an excessively hardening heat treatment. Unetched view (× 50).

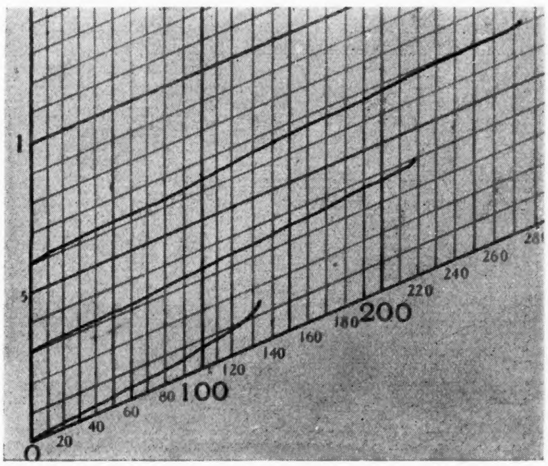


Fig. 4.—Stress-strain diagram of a typical 0.615 F. gold solder, in its quenched air cooled and slowly or oven cooled condition. Its physical properties are as follows:

	Tensile Strength Lb. per Sq. In.	Proportional Limit Lb. per Sq. In.	Elongation Percentage
Quenched	33,000	25,800	2
Air cooled	54,000	48,000	1
Oven cooled	67,500	64,000	0

It can be seen that its ductility is never great and in the two latter stages of heat treatment it approaches brittleness.

Tests were taken on two-inch gauge lengths 0.072 inch cast rods.

Elongation might drop well below 1 per cent, which is the borderline on brittleness. Oven cooling might be indicated on a material of low tensile strength in its initial or soft quenched condition, but it is not necessary to employ these materials in orthodontia.

It has been pointed out by Fig. 1, also partially by Figs. 2 and 3, that ductility decreases after exposure to red heat followed by air cooling. Practical experience has shown that most frequent breakage occurs adjacent and

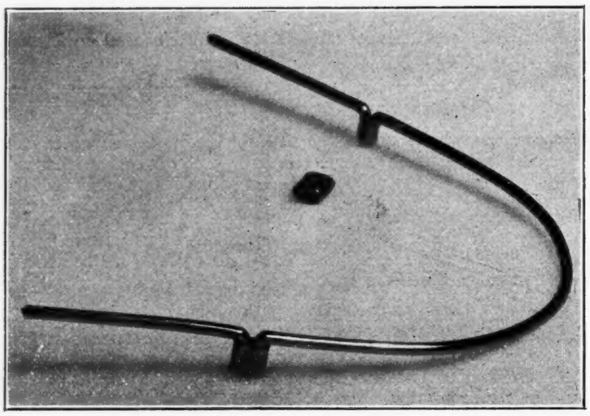


Fig. 5.—This is a type of one-piece arch as suggested by Dr. Ellis. The arch is semiformed and the wire itself is bent to form the archoring post. The tube is oval instead of half-round, consequently presents greater bearing surface and other mechanical advantages. This arch eliminates the half-round post and two soldering operations.

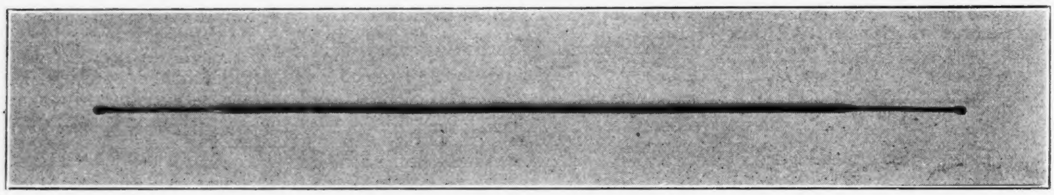
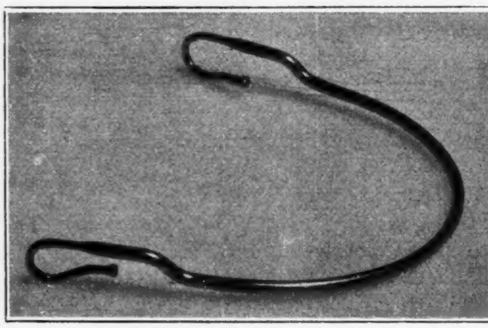


Fig. 6.—Diagram of the first step of a ready-made semiformed arch along lines suggested by Dr. Pullen. With this type of rach the metal is tapered down from 0.038″ to 0.025″ for a distance of one-half inch at each end of the arch. For obvious reasons, a small ball is left on the extremities.



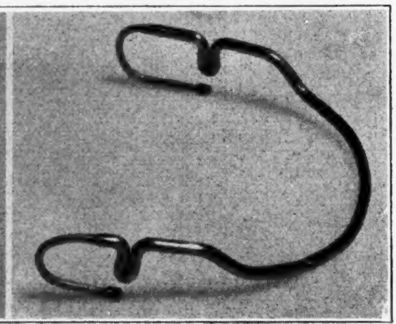


Fig. 7. Fig. 8.

Fig. 7.—The second and final step in a semiformed arch of this type. It is a fairly simple mechanical operation; the metal has not been subjected to any undue strain, and two soldering operations have been eliminated. The arches could be manufactured in a number of sizes.

Fig. 8.—A combination of the two arches previously shown. All operations are performed mechanically, and there is an elimination of at least four soldered joints, namely the half-round posts and the arch locking wires.

anterior to the soldered anchoring post. Solder has practically no elongation after hardening heat treatment.

A solution to this particular problem, as brought out by Fig. 4, would be a one-piece lingual arch. This type of arch has been suggested by Dr. Walter H. Ellis, and he has a number of such models in practical use, about

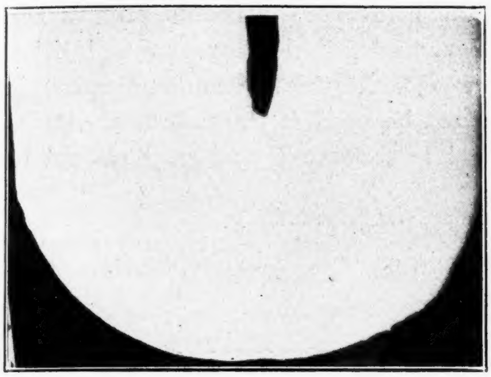


Fig. 9.

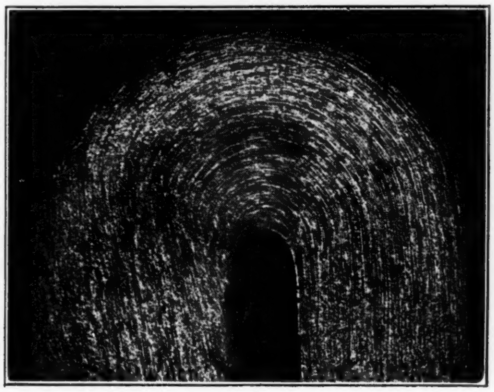


Fig. 10.

Fig. 9.—An unetched view of the sharply bent portion of the Ellis one-piece arch. It shows absolutely no fracture of the metal (×50).

Fig. 10.—An etched view of the same bend. It shows not only no fracture of the metal, but also the plainly defined lines of cold work (×50).

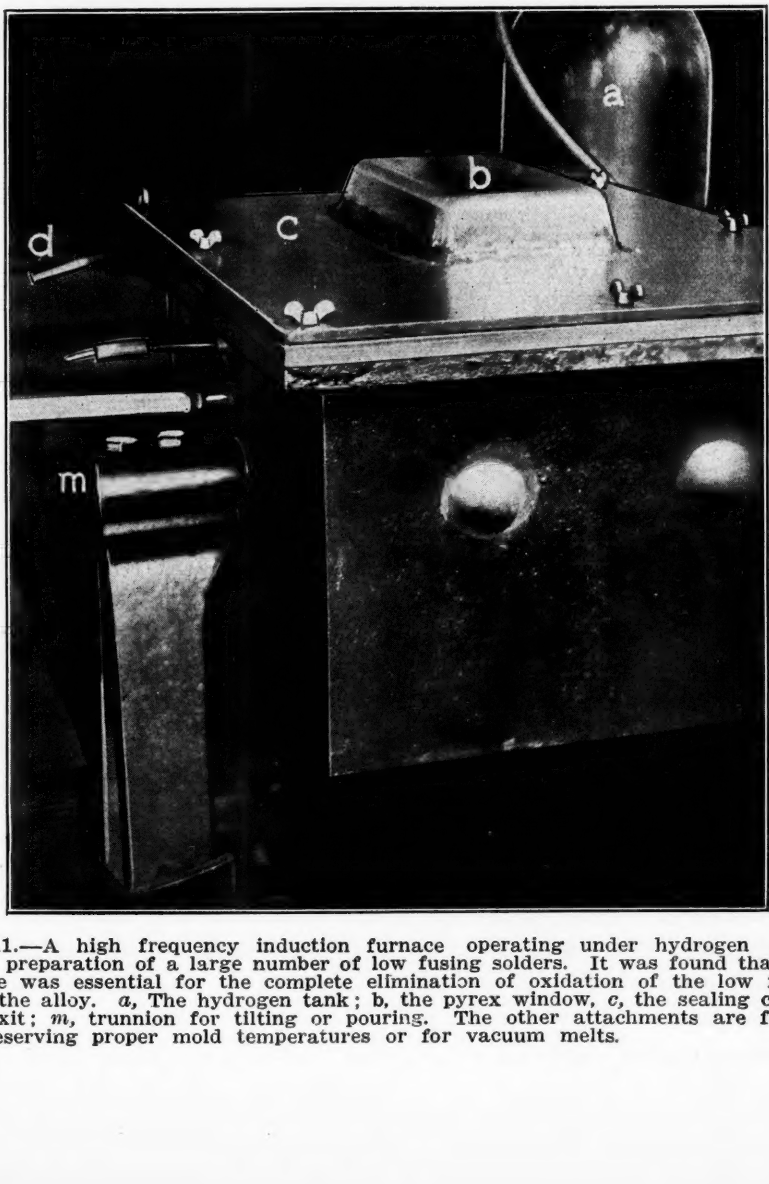


Fig. 11.—A high frequency induction furnace operating under hydrogen atmosphere, used in the preparation of a large number of low fusing solders. It was found that apparatus of this type was essential for the complete elimination of oxidation of the low fusing components of the alloy. *a,* The hydrogen tank; b, the pyrex window, *c,* the sealing cover, *d,* the hydrogen exit; *m,* trunnion for tilting or pouring. The other attachments are for the purpose of preserving proper mold temperatures or for vacuum melts.

which he will undoubtedly make a report. Dr. Pullen has also suggested a semi-ready-made arch which eliminates the soldering of the locking wires. A close study of both of these types of arches might disclose great possibilities.

Inasmuch as excess heat and prolonged heat produce embrittlement in both the wire and the solder, and solder must be used at the points of attachment of the auxiliary springs, it is logical to assume that solder should be specifically designed for orthodontic use.

The function of solder in dentistry is for two purposes:

1. The building up or filling in, such as in crowns or bridgework.
2. The uniting of parts.

Fig. 12.—Pyrex apparatus used in solder flowing tests. It was found that because of oxidation and other variable conditions proper solder flowing tests could not be conducted in the open air. It was concluded that both the solder and the metal on which it was being flowed should be completely enveloped in an inert or reducing atmosphere. Strips of 22-K plate, on which were attached small pieces of solder to be tested, were inserted in each of the prongs of this pitchfork-shaped apparatus.

The former use consumes by far the greater proportion of solder, consequently standard alloys are designed more particularly for this work. Solder of this type does not comply with orthodontic specifications. It should be of high carat, yet low fusing point and since it is to be used solely for the uniting of parts, it should be of reasonably low surface tension.

Careful observation of the lingual arch technic has disclosed the fact that the final adjustment of the arch is accomplished by heating the wire to a dull red temperature and adapting it more closely to the model with some sort of instrument, before it has had time to cool. All precious metal wires show vastly decreased tensile strengths at elevated temperatures, consequently this practice, unless followed with great caution, is exceedingly dangerous.

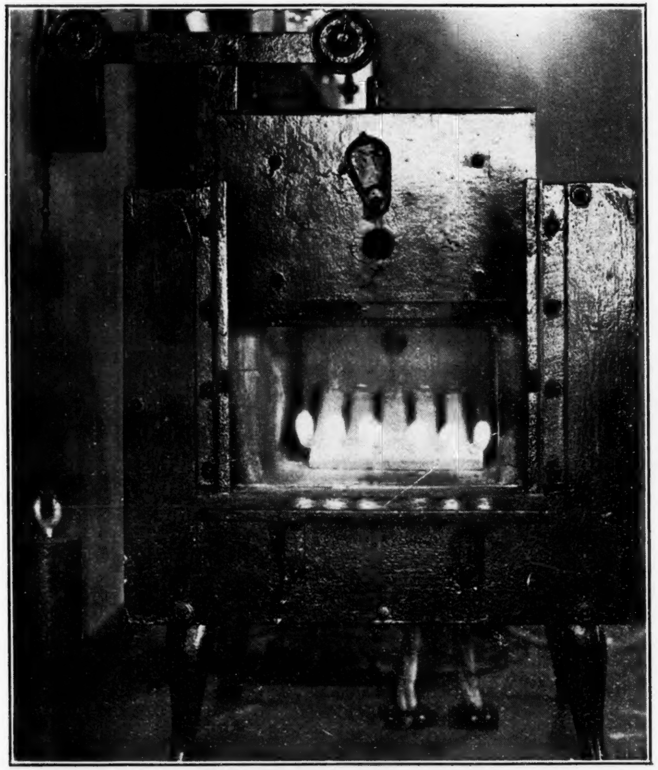


Fig. 13.

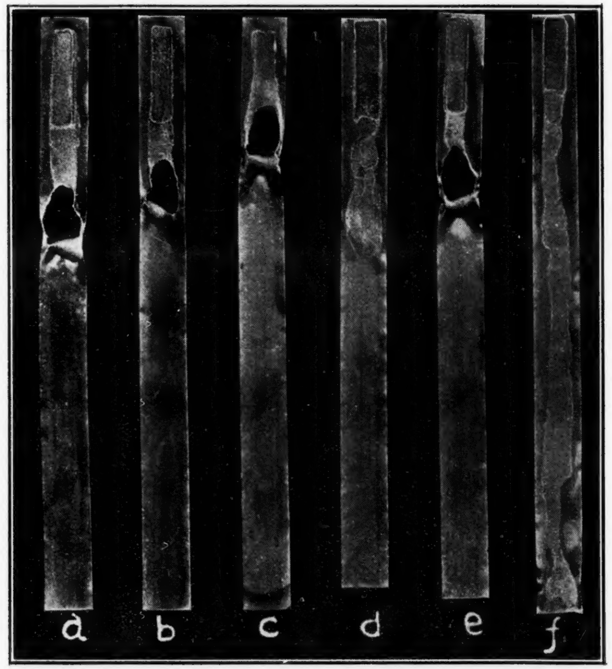


Fig. 14.

Fig. 13.—The apparatus shown in Fig. 12 was placed in an electric resistance furnace and heat slowly applied. A stream of hydrogen was passed over the solders to be tested. In order to avoid an explosion, the hydrogen was ignited at each of the jets of the apparatus. The apparatus was tilted at an angle of 15°.

Fig. 14.—This shows the result of solder flowing tests under hydrogen. *a* to *f* are strips of 22-K plate on which have been flowed six different solders, all of identical gold content. It is an easy matter to differentiate between them. *a*, *b*, *c* and *e* burned through the plate. *d* did not flow very far but nevertheless did not burn through. *f* flowed the entire length of the strip with no signs of burning through the metal. It would seem that this type of solder is best indicated for orthodontia.

It is also to be remembered that this is a form of heat treatment which will decrease ductility and increase probability of breakage. Improvement will be effected in this instance when the manufacturers deliver materials possessing greater tensile strength at these high temperatures or the orthodontist alters his technic.

Fatigue brought about by manipulation of the arch by the patient is a point which need hardly be mentioned here. Repeated stress, especially beyond the point of permanent set, will eventually rupture the wire. The rup-

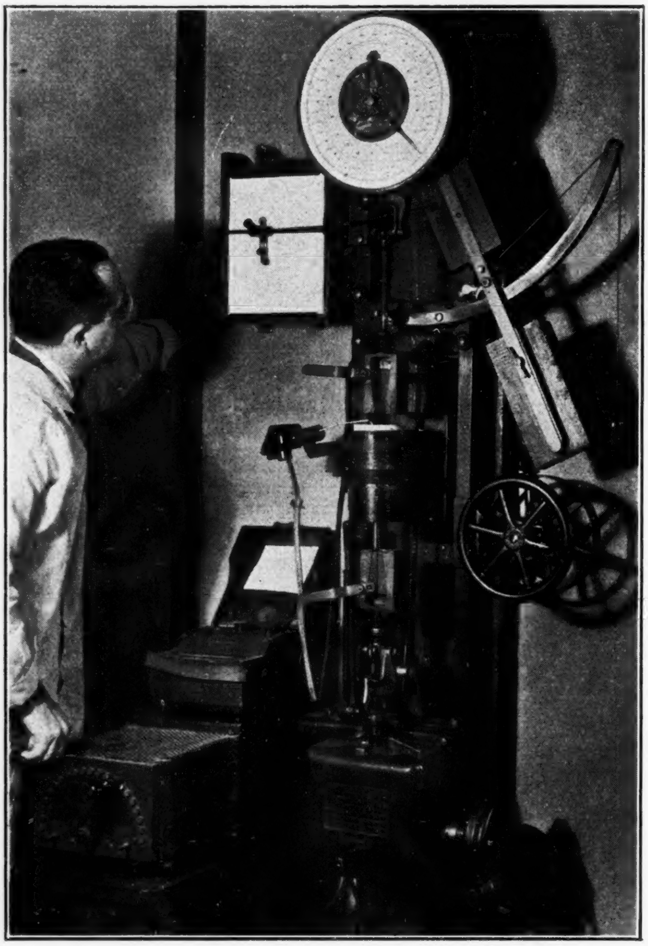


Fig. 15.—Apparatus on which were conducted the tension tests at elevated temperatures. A small cylindrical rheostat controlled resistance furnace, with small opening at both ends, was suspended between the grips of the tensile testing machine.

ture, however, is accelerated by excessive or prolonged heat in soldering, hot bending or other operation that tends to increase hardness and decrease ductility. In the event these factors are unavoidable, the arch should be so anchored as to prevent movement with the tongue.

Defects may occur in any material. There are a number of variables in the manufacturing of orthodontic alloys not entirely under control, such as pouring temperature, rate of pouring, mold temperature, nonuniformity, reduction during fabrication and so on, any of which might have bearing on

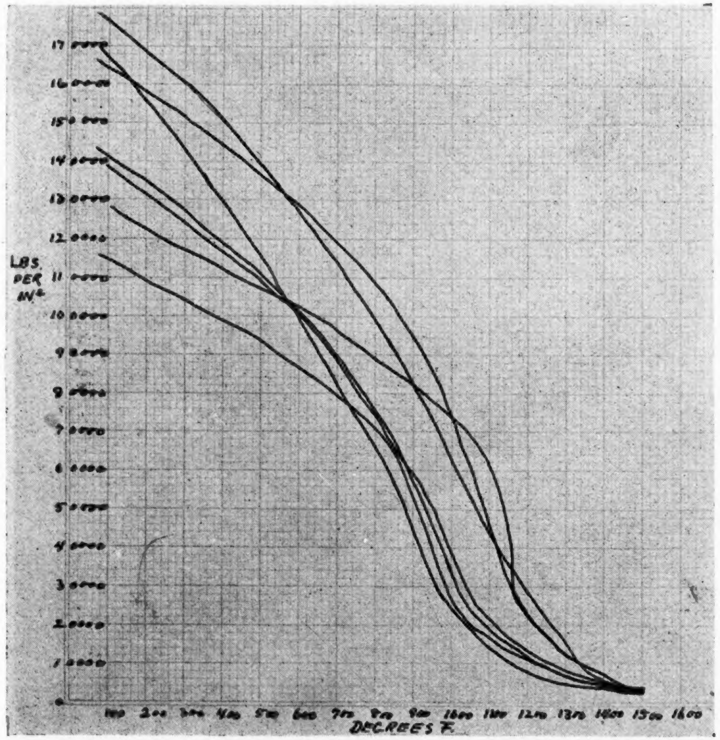


Fig. 16.

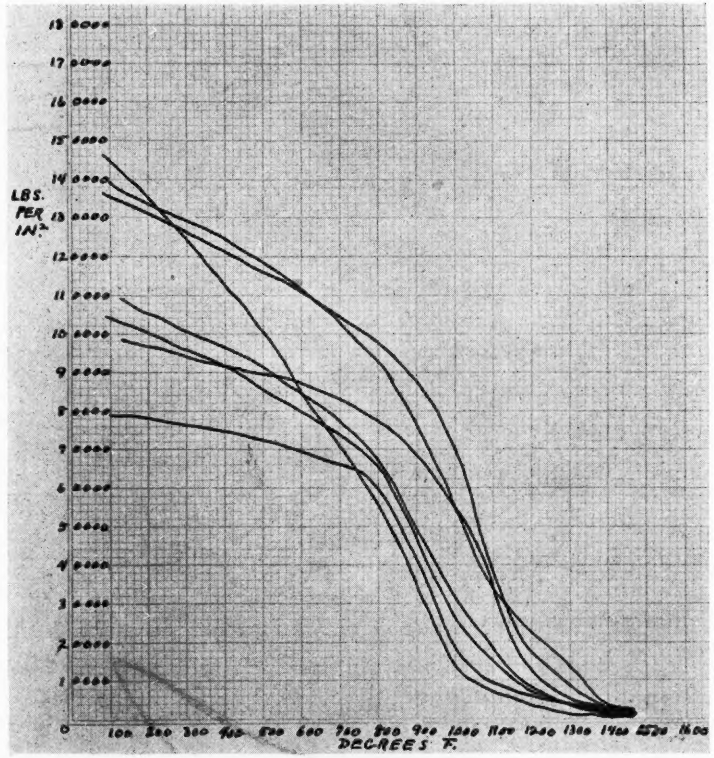


Fig. 17.

Fig. 16.—This diagram shows the drop in ultimate tensile strength of seven different wires, containing from 0 to 25 per cent of the platinum group metals, at temperatures ranging from room temperature to 1500° F. It can be seen that the tensile strengths drop rapidly, until at approximately 1500° F. they possess no strength whatever. This illustrates particularly the hazard of hot bending.

Fig. 17.—Similar to the previous diagram only illustrating the drop in proportional limit at elevated temperatures.

the finished product. Most manufacturers, however, are equipped with testing laboratories, and there has been great improvement in this respect.

SUMMARY

Breakage troubles may be decreased by using wires of greater ductility and less tensile strength. Until standardized alloys are adopted and until more uniform methods of heat treatment are advocated and reasonably priced

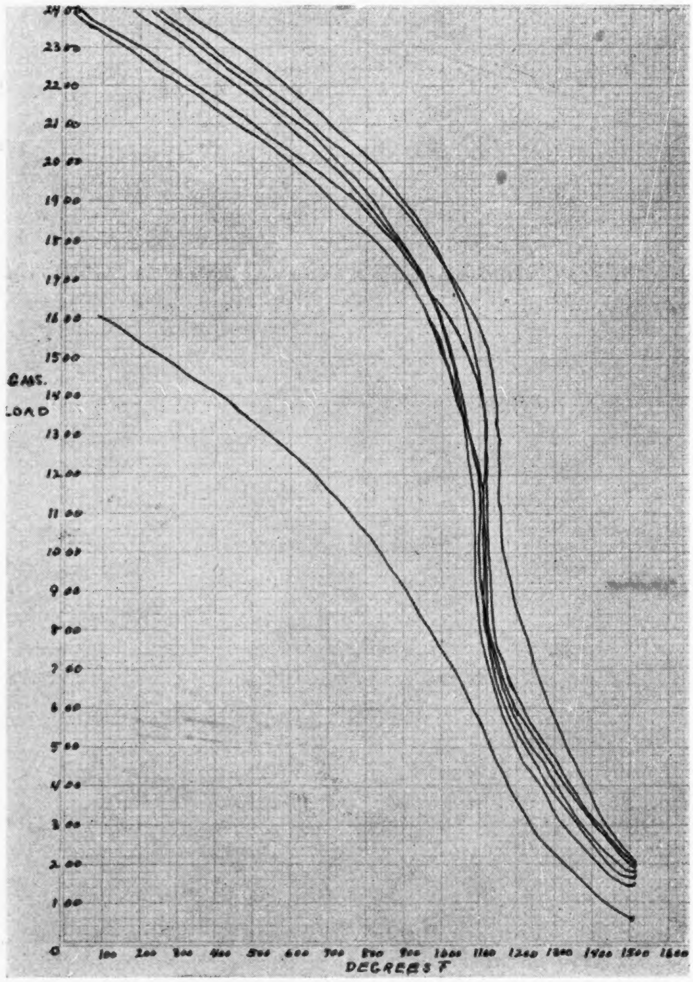


Fig. 18.—In order to conduct bending tests at elevated temperatures under more practical operating conditions, apparatus was constructed to determine strength under transverse bends. The vertical column represents grams load, the horizontal column, degrees F. This series of tests on seven different alloys merely verifies the previous conclusions.

accurate equipment is available, avoid the extremely hardening or oven cooling heat treatment. Many alloys are available possessing sufficient strength in their air cooled or even quenched condition. Avoid excess heat in soldering operations and use great caution in the bending of heated wires. The elimination of all possible soldered unions and complicated hardening heat treatments seems to be indicated at the present time.

DISCUSSION

Dr. Walter H. Ellis, Buffalo, N. Y.—It is indeed significant that today's orthodontic metallurgical problem is not one of obtaining more spring or tensile. Mr. Williams has shown from a metallurgical standpoint why this is undesirable, and we, from an orthodontic standpoint, are well aware of certain physiologic reasons why tensile strength of orthodontic metals should be kept to a sane minimum.

When we fully realize that breakage increases as tensile increases and ductility decreases, we will not ask for the ultimate in springiness as has been done in the past, but will choose alloys of just enough tensile to do the required work which is to stimulate tissue growth through pressure and with stability enough to remain in place without breakage.

I have been convinced for some time that the manufacturers have misunderstood our needs and supplied alloys of too high tensile with consequent liability of breakage.

A certain well-known manufacturer has lately been supplying orthodontic wire with considerable less tensile than his earlier alloys; even though those purchasing it were still asking for wire more springy than ever. This new wire is delivered in its softest condition and is vastly more efficient and satisfactory.

We have materials and technic that will do our bidding. We must not be too appliance-conscious; we must not be too concerned over materials as to blame difficulties that may arise from our own errors in diagnosis and treatment, entirely to faulty materials. The problem is more likely to be in the choice of the materials, their use and handling, and also of the method of treatment as relating to the biologic factors and its application to the case at hand.

The photomicrographs that Mr. Williams has shown with invisible fractures at bends in the wire, are further evidence of the great care that must be taken not only in the alloys chosen but in heat treatment and the handling of it as well. No wire is foolproof. I have no doubt but what many appliances have been put into active duty with similar faults present that later caused failure.

Mr. Williams offers evidence why soldering of or to the arch wire increases breakage at or near these joints. We have been painfully aware that they have broken but we have not always known why. As the damage to the wire increases in proportion to the amount of heat applied, a logical attack to the soldering problem is, as he states or infers, the use of solder that will melt at a somewhat lower temperature; this to be not a solder of lower carat necessarily but of low surface tension made up of component metals that will flow and unite with the parts to be soldered quickly and easily. This result is obtained largely through the original manufacturing technic that he suggests and describes so beautifully. I have used such a solder and it is fine. It is particularly useful in soldering finger-springs to the arch. It not only melts at a lower temperature than any other I have used, but also flows easily and, if properly used, makes a satisfactory joint, leaving the finger-spring and arch with nearly their original tensile and ductility.

However, any soldered joint has elements of weakness. The orthodontic wire is a wrought metal, and solder as applied is in a cast condition or a cast alloy. Any alloy in its cast condition is weaker than when wrought, therefore a solder joint should not be placed at or near points of great stress. These joints are likely to fracture under strain. Then again there is a possibility of alloying the surface of the arch wire by penetration of the solder, causing brittleness. This was brought out by Williams' photomicrographs, shown at our Kansas City meeting.

With this thought in mind another method of attack to the problem of breakage of arch wire is to eliminate as many soldering operations as possible.

If these breaks that occur at or near the soldered anchor post of the lingual arch are due to the unavoidable faults of all soldering operations on orthodontic metals, then it would be desirable to make the lingual arch of one piece, having no soldered joints. As a step in this direction the suggestion is made that such an arch can be formed of one continuous wire without a soldered or braised anchor post or lock; the anchor post to be formed by a loop of the 0.038 arch wire accurately fitting into a specially recessed tube to complete the

assembly. It is important, however, that this arch, looped post and tube be all made in accurate dies for absolute fit.

I have been thinking about this problem of a ready-made lingual arch for several years. It is rather intriguing to think of having the manufacturer make up the arches in a variety of sizes with the anchor post an integral part of the arch. Such a method would simplify the lingual arch technic considerably. It seems near realization, or at least an advance in that direction in this arch which Williams too generously terms the Ellis arch. We worked it out together.

The steps for the application of this semi-ready-made lingual arch are:

1. The selection of the suitable size for the particular case.

2. The shaping of it roughly to the dental arch, preferably to the model.

3. The soldering of the tubes to the anchor bands at the correct position to receive the anchor loops.

4. The final accurate fitting of the arch into the tubes, either on the model or in the mouth.

These are all steps in detail that follow naturally, logically and easily for the experienced technician.

Any indicated finger-springs can be attached at points well forward on the arch, looping them back if pressure is indicated in the premolar region, being careful to avoid any soldering operation on the arch near the anchor loop, keeping in mind the fact that soldering weakens the arch, particularly at points of stress.

I have a number of these new lingual arches in use in my practice. In my opinion this technic offers several advantages and so far has evidenced a step in the right direction: ease of assembly and the elimination of four soldering operations, any one of which may injure the arch by overheating. The anchor loop posts are always parallel to the long axis of the side arms of the arch and to each other, also in center of arch wire and at right angles to the occlusal plane. The anchor loop post is so firmly seated and locked in its tube when in place as to obviate the necessity of a spring lock wire.

The bending of that part of the arch distal to the anchor loop against the distolingual angle of the molar band and under a spur will cause torque or twisting of the loop within the tube giving any degree of snug fit.

It can be made up in nickel silver for use in charity and college clinics, the finger-springs to be attached with very low fusing solder, making lingual arch technic available in cases where the cost of precious metal appliances is prohibitive.

I will not go into any further detail here. My clinic at a later session covers the complete technic.

Dr. Herbert A. Pullen, Buffalo, N. Y.—It is an unusual treat for the members of this society to listen to such an instructive and practical paper presented by a metallurgical engineer of ability, and it is my belief that the closer cooperation between the orthodontist and the metallurgist that has been demonstrated in the last few years, and especially in a paper and discussion of this nature, has taught the orthodontist something more about the meaning of tensile strength, proportional limits, hardness and ductility, elongation percentages, fusion temperatures of wires and solders, quenching, air cooling, and oven cooling, than he could have learned otherwise.

On the other hand, the metallurgist has learned from these professional contacts that there are certain undesirable qualities of precious metal alloys in band material or wire, which, from a practical working standpoint, must be changed to suit the conditions of stress or strain which present in the daily technic of the orthodontist.

It seems to me that what we have been asking of the metallurgical chemist is to produce for us almost foolproof materials, and the writer of this paper, who has carefully studied our needs, assures us that there is still room for improvement along these lines.

Exceptional hardness, or high tensile strength not being desirable, if they are accompanied by low ductility, should be avoided in the alloying and heat treatment of base wires and auxiliary springs of the lingual arch, to which this paper more particularly relates it-

self, although the labial arch wires of small diameter such as the pin and tube arch wire, which requires a maximum of bending, heating and soldering, might well be included.

It is to the credit of the manufacturer that the base wires and auxiliary springs of the lingual arch do withstand many of the abuses to which the orthodontists put them, such as repeated heating and chilling in water, and pickling in acid, hot and cold bending, etc.

If the number of soldering operations upon the lingual arch wire could be decreased, especially in the region of the locking mechanism, the overheating of the arch wire may be materially reduced, and its original tensile strength and ductility more nearly maintained.

Some years ago I made up an arch wire with the locking spring of reduced diameter but forming part of the arch wire itself, as shown in Fig. 1. This reduces the number of soldering operations by two, as well as shortening the time of construction considerably.

By having the arch wire curved to arch shape, as well as having the half-round rods soldered in position by the manufacturer, as shown in Fig. 2, and the arch wire subjected to

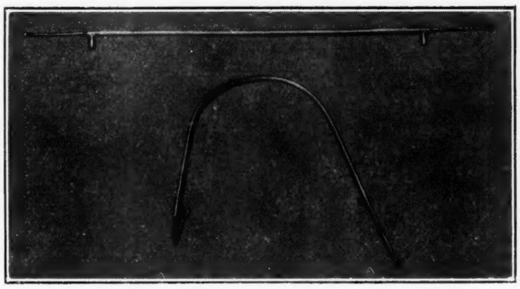


Fig. 1.

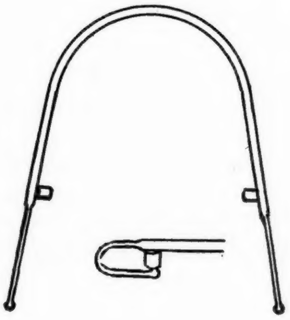


Fig. 2.

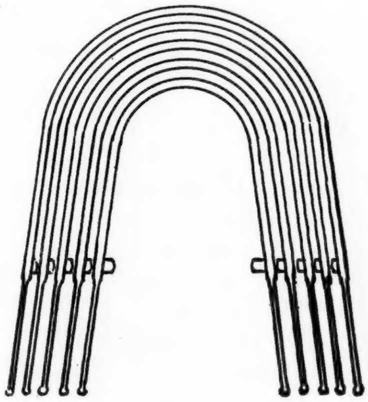


Fig. 3.

uniform heat treatment before leaving the factory, the hot or cold bending of the arch wire and the soldering of auxiliary springs with a lower fusing solder than that used for the attachment of the half-round rods may be accomplished with the minimum change in the quality of the original arch wire.

Again, I have had in mind for some years, and only just recently carried out to practical fulfillment in my own operative technic the construction of these semiformed lingual arches in graded sizes to fit any size of upper or lower dental arch, a few of these graded sizes being illustrated in Fig. 3.

These graded sizes of lingual arches, semiformed, and ready for adaptation by hot or cold bending to the form of the lingual surfaces of the teeth or the dental arch, have been made possible by the measurement of several thousand casts of both deciduous and permanent dentures, or mixed dentures, measuring with a copper wire the distance from the center of the lingual surface of one first permanent molar to the center of the first permanent molar on the opposite side.

It was found that these lingual measurements came within a certain definite range of minimum and maximum length with a gradation of not less than one-sixteenth of an inch, thus making it possible to have these arches made up in not over a dozen graded sizes by the manufacturer, with the possibility of reducing the number of graded sizes still more after a little more experience with their use.

Fig. 4 illustrates this semiformed lingual arch ready for insertion of the half-round rod on one side into the tube, and the arch wire adapted to the lingual surfaces of the teeth, with the tail locking wire of reduced diameter ready for recurving into locking position under the lingual vertical tubes.

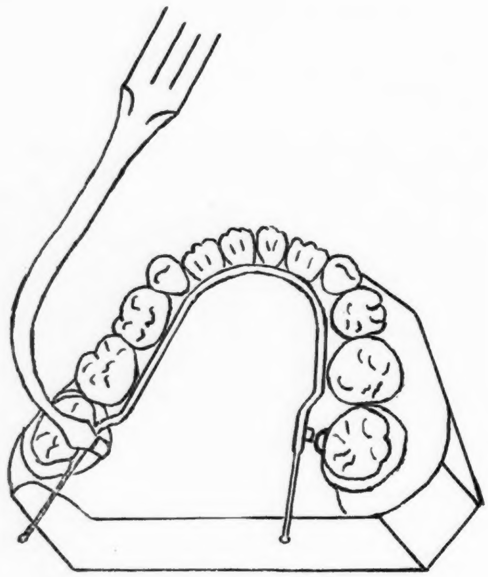


Fig. 4.

The detailed technic of these semiformed arches and their adaptation will be demonstrated in my clinic.

Solders should be of a free flowing character such as the essayist has described and not of too high fusing points in order that the arch wire may not be excessively heated at the soldering points. In this respect, also, the higher fusing point solders should be used for the attachment of the half-round rod in the locking mechanism, and the lower fusing point solders for auxiliary springs.

PROBLEMS INVOLVED IN THE STUDY OF WROUGHT GOLD ALLOYS FOR ORTHODONTIA*

By N. O. Taylor, Ph.D., Washington, D. C.

Research Associate for the American Dental Association at the National Bureau of Standards

A PROGRAM of cooperative research work on dental materials was inaugurated in 1928 by the National Bureau of Standards and the American Dental Association. The various phases of this program will be reviewed briefly and particular attention will be given to the problems which must be considered in the study of orthodontia materials which has just been started. It is impossible to mention other than the more important problems which make up this research program. These are discussed in more detail in the May, 1930, and February, 1931, issues of the *Journal of the American Dental Association.*

Amalgam Alloys.—The first study undertaken in the research program was an investigation of the properties of dental amalgam alloys. The preliminary survey of these materials showed that in 1928 only 6 of the 26 samples tested would meet the requirements of Federal Specification No. 356 for Dental Amalgam Alloys.

The findings of the 1928 tests were published carrying the trade names of the alloys tested. Several manufacturers promptly changed inferior products to comply with the Federal Specification. In 1929 tests were made on 44 alloys, and while some improvement was evidenced the majority of the brands tested were still to be considered unsatisfactory.

An American Dental Association Specification based on Federal Specification No. 356 for Dental Amalgam Alloys was adopted in 1929. In addition to the routine testing of materials the effects of mechanical amalgamation were studied in 1928, and in 1929-1930 a study was made of the effects of the variations in manipulation on the properties of amalgam alloys. The details of these studies have been reported in the *Journal of the American Dental Association,* April, 1929, and October, 1930.

Cast Gold Inlays.—The second part of the research program consisted of studies of the properties of materials entering into the making of inlays and of the technics by which the materials are employed.

A large number of inlay casting investments were studied, and a specification for this type of material was drawn up. The technics commonly advocated for inlay casting, where success is so largely dependent upon the properties of the investments used, were also studied in detail.

Inlay waxes and impression compounds were investigated and specifications drawn for both types of materials. The proportion of satisfactory to inferior materials was found to be low in both these groups as well as in the case of the amalgam alloys and casting investments studied.

*Read before the Thirtieth Annual Meeting of the American Society of Orthodontists, St. Louis, Mo., April 22, 1931.

A large number of inlay casting golds have been studied during the past year. The physical properties of these alloys together with suggested minimum requirements in the form of a tentative specification for inlay golds will be presented at the 1931 meeting of the American Dental Association.

Approximately two hundred dentists in all parts of the country make up a cooperative group assisting in the application of laboratory findings to practical inlay casting. This group is making substantial progress in their study, and their report will probably be made to the profession within the year. This report should bring together the results obtained in the scientific laboratories and in wide practical experience to the end that its findings and recommendations will be an important step toward the solution of this problem.

Specifications for Dental Materials.—The results of studies of dental materials are of general interest to the dental profession, but the individual dentist is not, nor has he any prospects of being, in a position to test satisfactorily dental materials. In the absence of any accepted standard of comparison, the dentist must use the mouths of his patients as an experimental laboratory and try one product after another until one is found that gives satisfactory service. This process is long, and the results obtained are often of doubtful accuracy.

Furthermore, by the time the dentist has discovered a combination of trade named materials which will give satisfactory restorations, some one or more of these materials may have been changed without notice. Then trouble starts, and he must experiment further to determine which material was changed and what may be a satisfactory substitute. The most unfortunate result of such a procedure is the harm often worked upon the patient who has unwittingly served as a laboratory.

The development of standards for dental materials is the most important part of the research program. The specifications adopted to date are not to be considered final standards. They are simply safe or minimum standards set up for the guidance of the dental profession. Materials which do not meet the requirements are definitely inferior in one or more properties.

The materials which meet a given specification still may show considerable variation in properties. Some are certainly more nearly the ideal than the others, but no statement of the properties of this ideal has yet been made. The minimum requirements of the specification are not intended as a rating sheet. Statements that the specification definitely shows one material in the acceptable group to be better than the others are misleading. Such statements are usually found in advertising claims and are based upon one product having higher values for some properties than other similar materials show. The standards are so set that all materials meeting their requirements should give good results when properly used. The method of use is such a large factor in the utilization of all materials that even good materials may be ruined by improper technics.

The proper use of specifications by an individual practitioner is to select for his use a product guaranteed to meet the minimum requirements for the given type of material. He may select the one which works best by his usual

technic or he may, after studying the properties of a material, make some variations in his usual methods to be certain that the material selected will be so used as to get the best properties in his final product. In any event he should aim for "better materials—properly used."

The tentative specifications for dental materials now available may be found in the *Journal of the American Dental Association* for January and December, 1930, and January, 1931. Some manufacturers are making improvements in the various types of materials, and the tentative standards will be revised to embody higher requirements as soon as it is evident that better materials can be produced consistently. The practitioner's part in this change may be one of acceleration if he will insist that all the materials which he uses meet the requirements of his association, and, in addition, he will be enjoying the benefits of the research which he is supporting financially.

Orthodontia Materials.—The study of inlay casting golds was completed early in 1931, and at that time it did not seem advisable to proceed with the study of denture golds until the present cooperative committee on inlay technic had completed its work and a similar group had been set up to cooperate in the study of denture materials.

Wrought gold alloys in the form of wires and bands are much used by the dental profession, particularly by the orthodontist. The President of American Society of Orthodontists had requested the committee in charge of the research work to include a study of wrought gold alloys in the research program at the earliest possible date. The committee wished to grant the request, and when it became apparent that the work of the cooperative inlay group must of necessity continue longer than the laboratory work on inlay materials, it authorized the study of this type of materials in 1931. This resulted in this particular item of the program being given consideration before the study of denture materials was begun. Samples of wrought materials were secured and work was begun on them early in 1931.

The Problem.—We may consider the study of wrought alloys now in progress as a problem or a series of problems which must be solved step by step through the combined effort of the laboratory, the manufacturer and the practitioner if we are to get as the solution of our problem and as result of our work "better materials—properly used."

The study of the problem from the laboratory viewpoint will be divided into several major considerations, and these will be presented at this time for suggestion and constructive criticism. They are:

1. The types of materials commonly supplied on the market.
2. The usual methods of manipulation to which wrought alloys are subjected in use.
3. The development of test methods which will best correlate laboratory tests with practical usefulness.
4. Possible changes in type of alloy or methods of manipulation which will produce better practical results.

As the problem progresses, the manufacturers of wrought alloys can assist materially in its solution by

(1) Assisting in the development of satisfactory test methods,

(2) Supplying materials whose properties are uniform,

(3) Supplying sufficient data on the behavior of their products to enable the user to get the best possible results by heat treatment.

The users of wrought alloys will contribute to the solution of the problem by

(1) Giving information as to their usual procedures in manipulating gold alloys,

(2) Trying suggested procedures exactly as directed,

(3) Varying their usual procedure to get the best results with a given material as outlined by the manufacturer.

(4) Insisting that the materials used in their laboratories meet the minimum requirements set for wrought alloys when such requirements are finally adopted.

Method of Attack.—The following outline covers in general the plan which is being followed in the investigation of orthodontia materials.

1. The first step in the investigation was to send questionnaires to a group of orthodontists selected by the officials of the American Society of Orthodontists in order to secure information on the methods of use of wrought alloys, the types of failures, methods of annealing, methods of hardening and names of alloys found to be satisfactory and those which were considered unsatisfactory.

The replies to these questionnaires gave considerable information on the types of materials considered as satisfactory for orthodontia uses. The trade names of alloys given serve as an aid in the selection of samples for test.

The study of inlay casting golds indicated that the current alloys were for the most part of good quality but that improvements are necessary in the methods of casting them. Similarly we find that the replies received in answer to questions concerning manipulation of wrought alloys show a great need for improvement in methods of handling the wrought alloys in the laboratory.

The methods of manipulation outlined included all variations from the use of annealed wire without any heat treatment to harden the alloy after the forming and soldering operations to the similar usage of hard drawn alloys. In the intermediate groups are found many variations in annealing hard drawn wire: brief heating to red heat and air cooling, electrical annealing and quenching, and furnace annealing for several minutes followed by quenching.

Methods of hardening are equally varied and range from complete absence of any treatment, through cold working by bending, heating to red heat and air cooling, to a variety of tempering processes which consist of holding the alloy at specified low temperatures for from ten minutes to an hour followed by slow cooling.

When these methods are considered in relation to their probable effect on the properties of the gold alloys, the conclusion most logically drawn is that the qualities of the alloys in general use must be excellent to withstand

so many varieties of abuse and still give satisfaction. The alloys are largely of one general type, and while small variations in treatment may be necessary, the wide variety of methods outlined would indicate that only a very small proportion of orthodontic appliances are so treated as to insure the more desirable qualities in the alloys used.

The variety of methods described indicates very plainly that a great deal of work must be done on the development of simple practical methods of treating orthodontia appliances to insure the best utilization of the desirable properties of the alloys employed and to eliminate many of the present abuses. It is safe to say that the principal part to be taken by the orthodontist in the solution of the general problem will consist of the application of metallurgically sound methods of manipulation and heat treatment in the production of his orthodontia appliances.

2. Manufacturers have been asked to contribute to the solution of the general problem (a) by designating those of their products which give general satisfaction in use; (b) by suggesting methods of testing which they feel will best differentiate good materials from inferior ones; and (c) by suggestions as to possible practical heat treatments.

The suggestions received as to heat treatment methods indicate that the manufacturers recognize the need for methods of treatment which are both simple and practical to insure the proper characteristics being present in their products when incorporated in the finished appliance. There is no doubt that the use of proper methods of treatment would greatly reduce the amount of material classed as unsatisfactory by the practitioner. Such a change should reduce the quantity of material which is returned to the manufacturer because of failure through application of improper methods and not because of any inherent faults in the alloy.

The loss resulting from the return of parts of wires or wires which have lost their identity is a large one and should be eliminated if possible. The manufacturers of dental alloys have permitted the return of materials on the basis of almost any slight dissatisfaction with their performance. There is no doubt that inferior materials should be returned for replacement, but the practice of returning materials has been greatly abused, and this abuse is reflected directly in the price of the wrought alloys.

The alloys supplied the profession in the form of wire may be obtained either hard drawn or annealed. The physical properties of an alloy will vary with its history, and the previous treatments to which it has been subjected should be known before any laboratory manipulation is attempted.

3. The laboratory work on orthodontia materials must include comprehensive studies of the effects of annealing, cold working, tempering and soldering. Data on the effects of these operations are available in small numbers from a variety of sources but test methods have been so divergent that it is often difficult to correlate the values given.

The study of the properties of wrought gold alloys has been divided into several parts. The first part of the work will consist of studies of methods of testing.

The published values for the physical properties of wrought wire have been obtained for the most part from tests made on samples ten inches or more in length. The methods of determining proportional limit and elongation vary from one laboratory to another, and the values reported for proportional limit have been based upon different definitions of that term. The heat treatment of the alloys tested has also varied from one laboratory to another.

This situation has been clarified to some extent in recent months by the adoption of standard test methods by certain gold alloy manufacturers and the agreement of the members of the group to advertise only values obtained by the methods adopted.

There is still work to be done on test methods, and it is believed that the use of shorter gauge lengths in testing wires will result in data more uniform in quality and which better indicate the properties held desirable for the type of alloys under consideration. Modifications of high precision extensometers have been developed for use on short samples and these are now in use. Tests are being made of different length wires, and future reports will include data from these studies of methods.

Samples of different types of hard drawn wires are now being tested to determine the length of time required to soften them properly when the furnace temperature is varied.

Coleman* carried out softening treatments on wrought alloys by heating them to 700° C. in the furnace and quenching in water from that temperature. This softening treatment is not sufficient to remove entirely from all wrought alloys the work hardness imparted by drawing. The time required to soften various alloys completely when held at 700° C., 750° C. and 800° C. is being determined.

The complete removal of hardening cannot be accomplished by simply "flaming" alloys until they become red hot and then allowing them to cool in air. This is a common practice but does not remove all work hardness from the alloys. The extent of the softening obtained by this method will also be determined.

The forming operations carried out on gold wires should be carried out on well annealed samples, and the completed appliance should be hardened by subsequent heat treatments if the best possible conditions are to be obtained in the metal. Partially softened wires will of course be less subject to breakage than the original hard drawn wire, but the bending operations will leave highly stressed sections in the partially softened wires which should be relieved by heat treatment.

Alloys which have been softened may in general be hardened by heat treatments which consist of slow cooling through the temperature range between 450° C. and 250° C., or by heating for various periods of time at temperatures intermediate between these, followed by quenching.

The first method is the one commonly recommended by manufacturers at the present time, as it may be carried out without the operator carefully

*Physical Properties of Dental Materials, Bureau of Standards Research Paper No. 32, R. L. Coleman.

controlling his temperatures. The hardening effect is dependent upon the rate of cooling, and some types of alloys are inclined to become excessively hard and brittle if the hardening period is prolonged.

The advertised properties of hardened alloys are based upon a variety of cooling rates. The time recommended for cooling from 450° C. to 250° C. may vary from three to thirty minutes with different alloys. An alloy which must be cooled in three minutes would harden further if the rate were decreased and might become so brittle as to be valueless.

The requirements used by several government departments are that samples be tested after a thirty-minute cooling through the hardening range. Under these conditions the hardened wire must show an elongation of 4 per cent or over, while the quenched material must have over 9 per cent elongation. Ultimate strengths of from 120,000 to 140,000 lb. per sq. inch are required in the hardened alloys.

It is improbable that these wires will ever be subjected to so slow a cooling rate as a thirty-minute one in practice, but materials which show 4 per cent elongation after this treatment will surely not be damaged if the usual treatment is accidentally prolonged. At this time it seems that it would be inadvisable to use materials which exhibit their most desirable properties after relatively rapid cooling, as these materials have a low margin of safety to counteract the effects of accidental slower cooling rates.

The investigation of softening methods will be followed by determinations of practical methods of hardening wrought gold alloys. The variable cooling rate previously outlined is not easily or accurately controlled and was advocated chiefly as a definite method which did give improved properties. The few dental laboratories with adequate equipment for measuring and controlling temperatures can perhaps better treat alloys by carefully regulating their temperature and then quenching the alloys after a definitely timed hardening treatment at that temperature when once this temperature has been stated by the manufacturer. At present such data are not uniformly available.

The majority of the individual dental laboratories do not have adequate facilities for temperature control. A furnace has been designed as a result of the cooperative dental work at the Bureau of Standards which appears satisfactory for all common dental uses. The details of this furnace will be announced later.

The hardening effects produced by heating for definite periods of time at temperatures between 450° C. and 250° C. followed by quenching will be determined. It is not expected that the same temperatures and times will give the most satisfactory results for all alloys. Variations in composition will require different treatments for proper hardening.

The practice of subjecting all types of gold alloys to like treatments in the laboratory undoubtedly accounts for much of the dissatisfaction with various materials. Treatments satisfactory for metals with high gold and platinum contents will ruin the properties of alloys with larger proportions of base metals.

Alloys having high platinum metal contents are soldered with low carat solders which have very different behaviors when slowly cooled. It is not unusual to find 14-carat-plate-solder used in fabricating an orthodontia appliance. This type of solder is very low fusing and commonly contains less than 50 per cent of gold. Casting golds with as low as 65 per cent gold are very often criticized and classed as undesirable for use in the mouth. Aside from the ease with which soldering operations can be carried out there seems little logic in the use of low carat solder with the high fusing orthodontia alloys.

Attempts to justify the use of low carat solder are based upon the fact that soldering can be carried on at low temperatures without overheating the wire. It is true the wire will not be melted, but the heating to the melting point of solder may change the properties of the wire, and these changes must be given consideration.

The more logical method of treatment of orthodontia materials based upon the metallurgical processes involved is (1) to soften wires prior to forming, (2) to follow this by a second softening treatment to minimize the effects of the forming operations and this in turn by (3) soldering with high fusing solders which may be hardened by the same general methods as the wires and (4) to give the whole appliance the hardening treatment best suited for the alloy used.

The study of orthodontia materials would not be complete without a study of the effects of solders upon the structures of the materials upon which they are used. While the work in progress is primarily concerned with the properties of the wrought alloys, some attention will be given to the solders.

The various problems indicated are now in progress. It had been hoped that definite data on the first items could be given at this time, but delays in replies to questionnaires and the preliminary work necessary in designing test equipment have made it impossible to do more than outline the problems in hand. Work on these problems will proceed rapidly, and the data obtained will be given to the dental profession at the earliest possible time.

DISCUSSION

Dr. Max Kornfeld.—Before discussing some of the main points brought out in Dr. Taylor's excellent paper, I wish to say that the orthodontists and the dental profession as a whole are indeed very fortunate in having scientists of the ability of Taylor and his co-workers at the Bureau of Standards endeavoring to solve some of our most important metallurgical problems.

It is apparent, from both Dr. Taylor's paper and orthodontists who were consulted, that the most important factor to be considered from a practical standpoint is the proper manipulation of the wrought gold alloys, and second, a better working knowledge of the major properties of the alloys used in everyday practice, such as melting range, annealing and heat treatment or, according to Coleman's terminology, softening heat treatment and hardening heat treatment, and also the mechanical properties of these alloys.

It will be entirely dependent upon the workers at the Bureau of Standards, the research men of our dental schools, and the manufacturers to evolve test methods that will serve as standards for the grading of wrought gold alloys to be used by the dental profession, but the practitioner must familiarize himself with the physical and mechanical properties of these alloys, such as melting range, heat treatment, tensile strength, yield point, elongation, proportional limit, etc., so as to be able to use them intelligently. The properties

of an alloy must be considered as a whole and not individually. It is granted that it is rather absurd to expect one to remember all the figures given by research men and manufacturers, but a simple method of handling this situation is to hang the charts issued by the gold manufactures in your laboratory and to consult them whenever necessary. Familiarity with the figures on these charts will help us get nearer the fulfillment of Dr. Taylor's slogan "better materials—properly used." For example, by knowing the melting ranges of the alloys used, a higher caratage of solder can be used and the hardening heat treatment will also be more effective.

It is true, as Taylor says, that the methods of determining the physical properties of wrought wires vary from one laboratory to another, but until definite methods of determination are given us we must of necessity depend upon the figures given us by the reputable manufacturers for their alloys. And again, until such a time as an accurate and definite procedure is evolved for softening and hardening heat treatment, it will be necessary to use methods that are both efficient and practical. The use of an electric furnace to soft heat treat wires is the ideal and most accurate method, but until an inexpensive furnace can be obtained, other means will have to be employed. A simple and efficient procedure is to place the wire on an electric hotplate having a plate thickness of one-fourth inch or three-sixteenth inch or by placing a piece of iron of the same thickness on a Bunsen burner and covering the wire with a lid of some kind. After heating for a few minutes the wire will take on a dark or steel gray color, a color that just has a tendency to turn red, and when this color is reached, the wire is removed and quenched. The proper temperature at which to soft heat treat alloys is approximately 700° C. (1290° F.). This procedure will remove the work hardness rather uniformly. In the hardening heat treatment process, it is absolutely necessary to use an electric furnace. The method advocated of heating to 450° C. and allowing to cool to 250° C. over a certain period of time (five to thirty min.) is all right for all practical purposes. Cooling over a longer period than the one advocated for the particular alloy may give rise during this cooling period to another compound which is hard and brittle, and it is this brittleness which we must avoid. After the soldering operations are complete, it is found as a rule that some of the springiness of the appliance is lost, and that the solder joints are brittle, and as these are not desirable features it is absolutely necessary to subject the completed appliance to a hardening heat treatment. We must, therefore, as Taylor also points out, soft heat treat our materials during the manipulative period and hard heat treat on completion. Air cooling also seems to be efficient because of the high grade of alloys obtainable, but even cooling is more accurate and definite.

A metallographic study considering the formation of eutectics, slip bands, etc., should also be undertaken in this survey. It is readily seen that there is a great need for research along these lines, and it is my belief that these research problems should also be undertaken by the metallurgical departments of some of our dental schools and that funds should be made available for such work.

Dr. John M. Clauser.—It is difficult to get the proper perspective of the work reported upon by Dr. Taylor unless one has been at the Bureau of Standards and has had the opportunity of observing the unselfish spirit of research that exists among the scientific staff at the Bureau. Ample facilities for carrying on this work are provided in what is probably the largest research laboratory in the world. Here, surrounded by ideal conditions, personal bias and hasty conclusions are practically made impossible. They have demonstrated by past performance that when they do arrive at their final conclusions, in general the last word has been said.

Now it is by no means any easy task for these research men to correlate the facts as to the best methods and procedure from the many varied interests connected with the manufacture, distribution and use of orthodontia wires. It would be almost too much to expect that all interests connected with this program will be entirely satisfied in the end.

Dr. Taylor's paper is an outline of the dental research being carried out at the Bureau of Standards, and we all look forward with a great deal of interest to the actual report of their findings. This report is more or less broad or general in its scope, rather than specific. Dr. Taylor did leave with us several definite recommendations. The first is, not

that the wrought alloy wires themselves need improving, but that there is a great need for improvement in methods of handling the wire in the laboratory.

Dr. Taylor reports on the existence of a wide variety of methods of annealing and heat treatment, or perhaps the lack of any method of heat treatment. In fact, we are forced to the conclusion that the present state of the art of wire manufacture must have given us some wonderful materials to permit such wide variations in heat treatment and yet in spite of this to give apparently satisfactory results in most cases.

Now if the various materials with their varying compositions, physical properties, etc., should all be subjected to the same standardized heat treating technic, it would seem that the personal opinion of the individual operators as to just what each wants or prefers in a wire, would still be at considerable variance, and some men would be dissatisfied with, say, the high value of a wire in tension, desiring a greater reserve strength of elongation or ductility, while some as a matter of personal opinion would desire the reverse. In other words, even if all phases of wire manipulation do become standardized as Dr. Taylor is inclined to suggest, still it might be going too far to expect all users of orthodontia wires to limit themselves to any one procedure.

The reason for suggesting this thought is that while Dr. Taylor apparently suggests a rather slow process of cooling a wire to harden after the quenching to anneal, it is also recognized that certain wires now on the market do not seem to require a long cooling period from 450° C. down, and some operators claim they secure ample physical properties by air cooling in the open without any oven or surrounding covering. The time taken to cool through the range of 450° C. to 250° C. is, after all, merely the determining factor of what physical properties are desired in hardness or strength as balanced by the ductility of the material. The most desirable relation between these two properties is going to be a rather difficult problem to settle, and the suggested methods of heat treatmnt may have to be left more or less open.

Please do not get the impression that I am differing with Dr. Taylor on this. After all, he is right because we must realize that the *best* physical properties can only be secured by the complete removal of local strains of work hardening induced by bending the wire in adapting, and annealing is necessary for this. Then to re-harden the wire uniformly, the annealing by quenching should be followed by slow cooling as suggested by Dr. Taylor.

The recommendation of using high grade, high melting solders capable of being heat treated, as Dr. Taylor seems to feel is the best practice, is at variance with the present-day practice of some who recommend the reverse procedure, namely, a low fusing solder which will melt and weld to the wire without alloying deeply into the surface of the latter, thereby changing the composition of the wire and, as a result, altering its desirable physical properties.

Dr. Taylor's suggestion on this means that the solder which acts as a cast metal can be made to approach the physical properties of a wrought wire by suitable grain refinement in heat treating. Undoubtedly the Bureau has ample evidence to warrant making this recommendation although at the present time many incline to the use of low fusing solders.

Naturally in a preliminary report of this kind, all phases of the research cannot be considered as definitely settled, and we understand, of course, that the Bureau must be given ample time to complete its work and embody the actual conclusions in its final report.

SOME OBSERVATIONS ON DIAGNOSIS AND PREVENTION OF MALOCCLUSION*

By P. G. Spencer, D.D.S., Waco, Texas

THE early treatment of malocclusion is a subject that is so closely related to that of early recognition and early prevention of malocclusion that it is difficult to find any dividing line. Considerable confusion results from the fact that proper stress is not given to the correction of some of the real causes of malocclusion, other than those termed local, and that are treated by an intraoral appliance.

Prevention is the modern curative, whether it be medicine, surgery, orthodontia, or what not. We may protect ourselves from typhus by building up greater individual resistance, even though the chance of an epidemic is remote. When we endeavor to prevent the occurrence of malocclusion, we deal with a very intricate problem. I take it that we are agreed upon the fact that in treatment of a great many of our dental ills the condition under treatment is in most cases a more or less stable proposition. The restoration of a tooth structure is daily becoming a better known and a very skillfully practiced art. But regardless of the high perfection of one's skill, the better method of treatment would be to prevent caries. This is where the complications arise, yet it is of far greater importance than the skilled corrections of any dental defect.

To foresee, to prophesy, and to prescribe for the correction or prevention of malocclusion, it is necessary to go far afield from the buccal cavity and to bear in mind that we are working on, cooperating with, and materially assisted by, a growing, living and developing organism. Inherent possibilities are present and will express themselves to what extent we do not know. Growth, development, inherited characteristics, environment, a proper balance and normal function of the internal secretions, and local causes added to numerous theories, beliefs, and facts, make it impossible to standardize any definite procedure that will apply to all cases. Identical twins do not respond exactly alike to any diagnosis or treatment, and any orthodontic treatment succeeds or fails in the exact proportion that we establish normal function of the associated parts of that particular individual. Mechanical orthodontic treatment would be a very simplified matter if the dental apparatus were a thing apart, if it might be tinkered with, reorganized, with a self-starter attachment, and carried around in one's pocket, as, for example, our timepiece when not in use.

The belief is common that rapid shifting of teeth to designated positions denotes great skill, great knowledge, or special occult powers. This belief is founded upon the theory that the teeth are very stable in their original positions. We have often noted the rapid shifting of one or more teeth, when

*Paper presented before the American Board of Orthodontia.
Read before the Texas State Dental Society, Fort Worth, 1930.

influenced by formation of pyorrhea pockets, and we see and hear much from the ill effects of trauma, and abnormal stress. Understanding these apparent facts cannot help but change our former ideas of retention, and to give added cause as to why we have relapses toward original positions or to other malposed positions. Establishing functions in a changed position or environment cannot be accomplished overnight; nor is any result stable or satisfactory that does not promote a condition which will continue to improve without continued future assistance.

Our growing children for obvious reasons wear ever changing shoes during the period from infancy to adulthood. (Most individuals continue changing even after that period.) During any growth period no two children progress exactly alike. Yet each can be progressively influenced by proper normal usage. I make this comment because of the fact that, be it pedal extremities or buccal cavities, we cannot have a standardized method of treatment to fit every individual.

I am not attempting to hold any brief for orthodontic failures, complete or partial; for I am only concerned in securing greater cooperation from all of you who are in far better position and have greater opportunities to do more toward prevention than has any other agency. Each of us, regardless of the different fields of work in which we strive to help, is daily aware of results that are far from satisfactory to us. The orthodontist's efforts compare favorably with other branches of dentistry. I have never seen any artificial dentures or dental restorations that would equal Nature's best handiwork, and I recall seeing in almost twenty years, only two cases of apparently normal permanent dentures, with full complement of thirty-two teeth that had arrived at their ideal state without outside aid. We shall not progress in our efforts unless we are always seeking to improve; yet we know that every patient seeking our services, yesterday, today, or tomorrow, might have minimized the help needed, with proper preventive measures. Evidently the individual is born with a development and growth force that with few exceptions produces an individual normal deciduous dentition. It is believed that with proper prenatal care, and elimination of defective habits after birth, we may feel reasonably sure of a fairly normal deciduous denture. I might mention that a marked difference is noted between bottle-fed and breast-fed babies.

Our second dentition is necessarily more influenced by environment or usage, and before its arrival the family dentist shoulders the greatest responsibility. The rhinologist more often than not does not see, and in the majority of cases makes no effort to correct improper breathing during the first few years of life. I frankly believe that a large percentage of malocclusions are primarily caused by this neglect. About 10 per cent of the adult patients really practice oral prophylaxis. The habit of noncare formed in the first eight or ten years is not often going to be corrected thereafter. Proper care of the deciduous teeth not only will help from an orthodontic standpoint, but will be favorable aid to you in preventing dental ills in later life, with your adult patients.

Regardless of early treatment or the lack of it, one very important fact is apparent to all of us who carefully observe our little patients during the period when the deciduous denture is lost and when the permanent denture is developing. We note that the majority of deciduous dentures appear to be apparently normal, and we are equally aware that during the transition period all the irregularities imaginable do, in the majority of cases, make their appearances.

Treatment of the case after the abnormality is present surely is not the desired cure-all; yet it is our present procedure. One problem before the dentists today is to find and correct this apparent breakdown. Most human ills are preventable or amenable to treatment when we have present the condition which we term good health. Not always, but in a majority of cases, we find our healthy little patients have a better chance to avoid malocclusions. Also we detect the manner and method of growth and development of the dental apparatus of other forms of animal life in which we see almost universal normality. Then we find that we are fairly well convinced that normal usage and proper development and environment are definitely missing in our scheme of modern civilization. The dog gnaws his bone, and sad-eyed bossy chews her cud, but our youngsters are not going to develop blue ribbon arches unless they have to masticate something more solid than pap and pea soup. Their diet may be and should be balanced as to calories, proteins, carbohydrates, vitamins, etc., yet it does not promote a great amount of stress on the dental apparatus for the individual to secure its portion of bone building materials exclusively by the cod liver oil route.

For years we have been taught that above all else we must retain the deciduous teeth for as long a time as possible, or in all cases until they become loose. We are all prone to go from one extreme to another; be it retaining all nonvital teeth, or wholesale removal of them. If an examination is made of one thousand mouths of children, one will readily note the haphazard system of removing deciduous teeth. The deciduous teeth are lost in almost the same sequence as they made their appearance. Radiographs of unerupted teeth definitely show there is a prearranged plan of replacing the deciduous teeth, and this plan is, more often than not, interfered with by the improper removal. Time without number we have all noted the deciduous mandibular canines being lost to accommodate the mandibular lateral incisors, when if the first deciduous molar had been under x-ray observation and properly removed, we should have been rendering aid to the normal occlusion instead of lending assistance to abnormality. Too early removal provides equally as many pitfalls, but the improper removal, be it deciduous or permanent teeth, is just as vicious and will cause just as much grief, for we shall be in the same position as the Dutchman and his wagon tongue: "He cut it off four times and it was too short yet."

The assertion is often made that when all first molars have erupted approximately in the sixth and seventh year, and are properly locked in occlusion, the keystone of the arch is established, while as a matter of fact, the first molars are not in proper occlusion until the twelfth year, or until the shift has occurred after the loss of the second deciduous molars, and it is then ma-

terially assisted if the mandibular deciduous molars are lost shortly before the second maxillary deciduous molars. Delayed removal definitely aids in causing certain types of malocclusion, for example, the vertical growth of the alveolus.

The permanent teeth numbering thirty-two, replacing twenty deciduous teeth, naturally require a larger arch for correct replacement. Do your little patients show definite spacing of the incisors between the ages of four and one-half to six years of age? They should if they are healthy growing children, breathing properly and eating balanced ration that requires mastication. A faulty tooth, or too early loss, or too long retention, may cause the cessation of mastication on one whole side. If so, the growth will be retarded more or less in this area. This retarded growth is ample evidence that bone growth is influenced by stimulation of muscle pull or stress. An orthodontist friend of mine who is an ardent advocate of a great number of muscle exercises as a necessary aid in orthodontic treatment tells me that in less than two years' time after showing and demonstrating to his patients, he made considerable changes in his own case, for example, it was necessary for him to wear a size and half larger collar on account of the exercise which has for its object the development and function of certain muscles attached to the hyoid bone. Certain lip exercises are vitally necessary to gain desired improvement. The benefits thus attained rest solely with the patient. It is something you cannot do for him. However, it is easy to see results if he will cooperate and follow your instructions regularly. It is just as reasonable to expect benefits from developing a muscle function in muscle tissue as it is to see malocclusions develop from such habits as lip-biting, tongue- and thumb-sucking.

Making any definite rule in diagnosis is impossible. Any rule will vary to the full extent that individuals vary. The composite outline of one thousand oak leaves would be far from what we see as the outline of a single oak leaf. Yet we are basing our ideal of normal on the sum of what we believe to be correct in many individuals. Any definite rule would have to provide a very numerous amount of exceptions. Any definite dimension of arch size and form must vary at different ages; and as growth follows a plan of periods of acceleration and rest periods, and as Nature chooses her own time for such changes and also controls the duration of such periods, we must necessarily give considerable leeway to any rule outlining our so-called normal. Local conditions that may be present that retard or prevent progress can be readily observed, and if possible, should be removed or corrected. But promiscuous tinkering with Nature's efforts will sometimes retard or defeat normal progress. Any form of assistance in treatment must always be the kind that will assist, and at the same time permit all associated parts the chance to function and progress naturally if they so desire.

Banding, uniting, or ligating any tooth or teeth that makes no allowance for some self-governing control is contrary to our knowledge of cell metabolism. Statistics compiled from time to time with comparison of adult cases, and tooth measurements lead us to believe that the deciduous arches should not be permitted to lag too far behind in gaining greater width before the advent

of permanent teeth. Spacing of incisors is one evidence that we are securing the desired growth. I feel some degree of satisfaction if the palatal measurement between the first deciduous molars is in excess of 28 mm. at the ages of four and one-half to six years. A vast majority of our malocclusions would be eliminated or greatly benefited if they were assisted in gaining a little arch width. High vaults in maxillary arches are always associated with very narrow arches. If any noticeable improvement is ever attained in the reduction of high vaults, early assistance must be given, prevention rather than correction. Normal breathing during the first half-dozen years of life will lend better aid than any other agency. Some men believe that treatment in later life makes no improvement of this condition. I think the vault is lowered in many cases, but in the majority of cases treated that are nearing the age of puberty, or older, we may gain a greater width, but the apex of the vault remains the same, and in those cases of excessively high palates it is impossible to secure a 100 per cent result in normal breathing.

Early loss of deciduous teeth from faulty tooth structure is not a black mark against a family dentist. The beginning of that trouble started in the seventh to ninth week of intrauterine life. Also the tooth buds of the permanent teeth are in evidence several months before birth, calcification beginning about the fourth month before birth. Can we render a real service to our patients or prevent future dental ills without the aid and cooperation of our medical brethren?

Several systems or methods have been advanced from time to time outlining the different classifications of malocclusions. Briefly these include three divisions: (1) that condition where the mandibular arch is displaced forward to its apparently proper position; (2) the mandibular arch displaced posteriorly to its apparently proper position; (3) both arches being in harmony as to position, but with numerous types of irregularities present. Present methods of diagnosis show that the dental arch cannot be taken as a separate unit, but must be viewed as a part of the whole body. We cannot take the first molar as a fixed point to work from without taking other things into consideration. Yet we find objectionists to the first molar theory basing their diagnosis on the position of the canine, and attempting to prove their findings by measuring from certain points on the face and cranium, such points being as a matter of fact really "on the move." These points vary on every individual, and are also on living, growing, changing tissue. The first difficulty in making orthodontic diagnosis is apparent when we consider that in assisting any dental apparatus to suit the functional needs and possibilities of that particular individual, it must also develop with the changes taking place in that individual.

The three classifications just mentioned each have many subdivisions and combinations from all classes, which make an added difficulty to overcome and to consider. Approaching our problem with this in view makes us realize that the causes of malocclusions have classifications just as numerous and as mixed as the resulting anomalies.

With this sketching and rambling preface, we must realize that treatment of any case of malocclusion cannot follow any standardized method. The

universal appliance has not arrived, and many mechanical devices now in use are really retarding rather than assisting.

The purpose of this paper is to point out the fact that if any orthodontic treatment is to be attempted, one must first give the problem some study other than that the idea of shifting teeth is merely a mechanical proposition. Simple cases (although I have never seen one) usually present unforeseen complications, and equally as often we see apparently very complicated cases respond to treatment in a manner that exceeds our expectations.

The last mentioned has not been solely as a result of great skill or proper mechanical assistance, but rather a welcome response from the oral cavity. Frequently I have heard some of my orthodontic friends remark that many cases under treatment that had been assisted to some extent, made a very pronounced improvement during a rest period of several months' duration, when all appliances were removed. Even though I may be misunderstood, I cannot let this opportunity pass without condemning the apparent increase in treating orthodontic cases by correspondence methods under the direction of dental laboratories. Any dentist who feels competent to construct a properly made inlay or similar dental restoration should also be able to construct an orthodontic appliance. The same dentist who would vociferously condemn a fellow practitioner for placing a tin can crown, will permit a laboratory possibly a hundred miles away to diagnose his orthodontic cases, using only plaster casts, construct appliances with full printed directions, and presto! another miracle has been performed. It is a disgrace to our profession that dental journals permit such bombastic statements and advertisements as are seen monthly appearing in their pages. Any conscientious orthodontist who is really having a limited amount of success knows full well from the difficulties met daily in his practice that a fancy, shiny, well-soldered appliance is not the answer to successful orthodontia. The laboratory is not concerned in anything except the financial intake. They are not spending sleepless nights worrying over root absorption, not so long as you send them $10.00 with your order, or the package is delivered C. O. D.

The opposite side of the case is presented when we know that so many children need some attention and the impossibility of their making long trips to an orthodontist. I grant you something should be done about it. Our state society has for years put forth an effort to present courses of orthodontia at its annual meetings. Personally, I have objected to any such courses that consisted of only appliance construction, as that is simply starting at the wrong end of orthodontia. Courses in prosthetics, crown, bridge, etc., are possible and have improved the standard of dentistry in our state during the past few years. But it must be remembered that all of us taking such postgraduate work have had considerable experience and previous instruction in the subjects taught. Under Doctor Arnold's direction a course is being given at this meeting, and I am sure it will be of benefit, but the fact remains that those interested in orthodontia must devote equally as much time, study and effort to orthodontia as they are giving to the other branches of dentistry if an equal amount of success is to be achieved, and the mystic lure of a great financial reward to be derived from practicing ortho-

dontia will soon disappear behind the cloud of disillusionment. Attainment of mechanical skill soon will be superseded by, "What, why and how come."

In closing there is one additional thing I regret the need of mentioning, lest I be accused of lending aid to, or taking exceptions to, the arguments of our Bosworthian friends, and that is, the subject of *your* fees, not mine, in payment for your preventive treatment, advice, comments, and the supervision of your little patients. The majority of your daily efforts and also of mine are expended upon curing defects, instead of eliminating causes. If you do not want to care for deciduous dentures, if children's teeth mean only to remove an aching tooth from a squawking child, and nothing else, then be fair enough to the little patients' welfare and refer them for proper attention. But you can be perfectly assured that if you devote the time that is necessary properly to advise, instruct and teach, and if you cooperate with the parent, the family physician, etc., you will find a very appreciative father and mother, and the income derived therefrom will far exceed the exaggerated opinion that is prevalent regarding the amounts paid for orthodontic services. The physician and the surgeon make charges for consultation just the same as when they administer a pill, and often the advice is of greater benefit to the patient than the results from the pill or knife. Our efforts toward prevention may in time eliminate the orthodontist, but as we have to start with the unborn babes, I feel safe for some time to come.

The hope of real prevention of malocclusion does not rest with the orthodontist, for in the vast majority of instances he first sees the patient after the abnormality is present. If any progress is made in prevention, the family dentist must play the important part. Our dental problems, be they caries or malocclusions, must be more thoroughly understood by one who in recent years is apparently moving out of the picture, namely, the family physician, and they must be understood by his successors, the pediatrician, the rhinologist and the dietitian, in fact, all the specialists who have for their aims the advancement of good health. All of them will be equally willing to help when they understand the part they play in preventing dental ills. So far, we have only reached the point in making them believe that preventive dentistry is a scheme to secure more work for the dentist, instead of a desire to render greater service, and the belief that orthodontia is more or less a fad, or a special privilege for the upper classes, not realizing that prevention will benefit the masses, equally as much as a favored few.

I realize perfectly that the general practitioner wants concrete and definite advice and instructions that he can follow in treating or in referring his patients in need of orthodontia. I have attempted in this discussion to impress you with the need of a better understanding of the orthodontic problem, that the manner or method of the mechanics employed is of minor importance. Lending your aid toward prevention of malocclusion makes it necessary that you study the orthodontic problem equally as much as you do your operative, surgical, or denture work. The published proceedings of the American Society of Orthodontists over a period of five years will offer a basis with an outline to other avenues of study. Remuneration will follow in the exact proportion to the effort expended.

The dental profession is steadily advancing and accepting its responsibility in the prevention of systemic ills, and I have no doubts regarding the part we shall play in the future in doing our part for the advancement of good health.

HABIT AS AN ETIOLOGIC FACTOR IN MALOCCLUSION*

By E. B. Arnold, D.D.S., Houston, Texas

FOR the past few years at our orthodontic meetings we have listened to many papers on the treatment of malocclusion of the teeth and dentofacial deformities, and in the majority of these papers the treatment of the cases presented has been outlined rather briefly. Rather have these essayists been emphasizing too greatly the importance of the construction and application of the particular mechanical appliances used than in attempting to point the way to effective treatment. With the exception of the cursory examination of the mouth very little time has been spent in diagnosing the case. However, at recent meetings, I am very glad to say, there has been a marked tendency toward getting away from the mechanical treatment, and greater importance has been placed upon the proper diagnosis of malocclusions. The latter has made great strides and has been a remarkable achievement in the orthodontic societies, being of an inestimable help and value especially to the young men following the practice of orthodontics.

I feel that the men who have had years of experience heretofore, recognize in its fullest importance the value of a correct diagnosis, but I regret to state that in my opinion the average young orthodontist with little practical experience until recently has not realized significantly the great importance of a proper diagnosis. To the contrary he has been devoting too much of his thought and time to the construction of mechanical appliances. We should rejoice that this deplorable situation in the orthodontic world is passing and that a new era of thought leading to the proper diagnoses and study of the etiology of our cases is reigning within our midst. If we are to be successful in our treatment, we must have a proper diagnosis to start with, and this diagnosis must include a thorough study of the etiologic factors pertaining to the case. These factors must be known before any plan of treatment is considered. The physician of today no longer writes a prescription for a pain until he is positive in his own mind that he has found the etiology of the pain. It would be utterly foolish and unscientific for him to treat the symptom and not the cause, since he certainly could not expect a permanent favorable prognosis in this manner.

In the study of etiology of malocclusion we have many factors to consider, but as I have been requested to limit my discussion on habits as an etiologic factor in malocclusion, I shall not enumerate the many others.

Habits may be acquired at an early age. The newborn baby that is artificially fed is very prone to contract habits. He soon becomes accustomed to the nipple, which having been used for some time has become more pliable and which with its enlarged opening offers little resistance to the nursing process.

*Paper presented before the American Board of Orthodontia.

When given a new nipple the baby will refuse to drink, inasmuch as he has to work harder for the milk. Thus the stimulation which he needs for proper growth and development of the jaws is not derived. This may be called the habit of ease, and when acquired may persist through the child's life.

The breast-fed baby does not acquire this habit, since he has to work very hard for his food and in thus working naturally gets the proper exercise of the muscles which in turn stimulates growth.

When the bottle-fed child is old enough to have solid foods, it is quite natural for him to shirk the proper mastication of these inasmuch as his muscles of mastication have not been trained for this heavy work. The child is then given mushy or soft food which has been run through a sieve, and the function of mastication is lessened; consequently growth and development are not at their pinnacle.

This deplorable habit was brought to our attention as early as 1863 by Dr. John Hugh McQuillen in a discussion of Dr. G. Foster Flagg's paper. He states: "The disposition on the part of parents to permit their children to indulge a preference for soft food, almost to the entire exclusion of everything that requires a decided effort in mastication (as instanced in the rejection of crusts of bread, etc.) was also highly reprehensible. The force demanded and the shock attendant upon the mastication of hard food was of decided advantage in enlarging and expanding the maxilla. The attention of parents should be directed to these facts."

Thumb-sucking has long been recognized by the orthodontic profession and is mentioned as an etiologic factor in all present-day textbooks, as a very serious and positive factor in the production of malocclusion. It is the most common of habits and very often the hardest to correct. Children usually acquire it during infancy when the parent or nurse, and many times the physician, regards it as harmless or even pleasing. But when we reflect on the mechanics of maxillary development, on the ease with which growing tissues are molded into form, and on the constancy of this subtle influence, we readily appreciate its gravity and source of harm when continued for a long period. The recognition of thumb-sucking as a factor in producing malocclusion has not been a recent discovery. We find that as early as 1834 Dr. William Imrie in the "Parent's Dental Guide" stated: "Irregularity is due to the want of development of jaw bone. Thumb-sucking intemperance of various kinds, confused with artificial modes of living introduced by civilization, all have a tendency to prevent the development of the bones."

Dr. A. Nasmyth in "Researches on the Development, Structure and Diseases of the Teeth" in 1839 stated that "A projecting upper jaw is often the result of a habit of sucking the tongue or finger in infancy."

In 1863, Dr. J. H. McQuillen calls attention to thumb-sucking as follows: "A common practice among infants after weaning, and frequently continued for years afterward of sucking their thumbs, was a prolific cause of that form of irregularity in which the superior incisors bulge forward and rest upon the lower lip."

Many mothers have brought their children to me for consultation re-

garding thumb-sucking. The ages of these children have ranged from six months to fifteen years. My personal experience of the habit is that if broken in time, even as late as four years old, the normal muscular function of the lip muscles, cheek, and tongue will correct whatever deformity is present and that proper development of the arches will ensue. But, I have yet to see a case where a child has habitually sucked its thumb until seven years of age which will correct itself without orthodontic interference.

I have found in my experience with an habitual thumb-sucker that the teeth usually present a posterior occlusion, with labioversion of the maxillary anterior teeth and a very narrow V-shaped maxillary arch and a retrusion of the mandibular incisors, giving the mandibular arch a square appearance. Along with the above complications, I have found in the majority of these cases unilateral lingual occlusion of the maxillary arch.

Dr. Samuel J. Lewis of Detroit before the American Dental Association in Washington, October, 1929, gave a very convincing paper on thumb-sucking as a cause of malocclusion of the teeth.

The problem of correcting this habit is a very difficult one. There are many ways, such as appealing to the child's will power and pride, the taping of thumbs, the adapting of sleeping garments, the using of gloves, aluminum mits, elbow cuffs, silver thumb cribs, bitter medicines, the banding of the anterior teeth with sharp spurs, etc. Dr. Dunlap of Johns Hopkins University has a very unique, and I believe a very positive, method in breaking this habit, namely, making the child conscious of the habit by having it suck its thumb for ten minutes every day before a mirror until the habit is broken.

We also have malocclusion caused by sucking the first and second fingers, with or without the thumb; but those cases are very few as compared with thumb-sucking. However, they produce some very disfiguring malocclusions and deformities which are very difficult to correct, especially if the habit has been practiced over a period of years.

The biting of the lower lip, or lip-biting, exerts a very deleterious effect upon the proper growth and development of the maxillae and mandible. The constant biting of the lower lip tends to move the maxillary anterior teeth labially, and the mandibular anterior teeth lingually, causing an infraversion of both the maxillary and the mandibular anterior teeth, thereby establishing open-bite or infraclusion of the anterior teeth. The molars may elongate, exaggerating the open-bite.

Sucking of the lower lip, or lip-sucking, which I do not think is quite as common as lip-biting, I have found causes a greater deformity than lip-biting, since the pressure is greater and the habit is continuous throughout the twenty-four hours of the day with the exception of the time that the child takes in eating. I have seen three children with this habit. In one case a girl of five years of age had developed it to such a great extent that the lower lip was stretched so long that it came in contact with the soft palate. Upon persuading the child to relax the lower lip there was presented an extremely overdeveloped one which drooped down so far that it gave the child a hideous appearance. From this constant habit the maxillary anterior teeth were in

extreme labioversion, and the mandibular anterior teeth were very much in linguoversion. The mandibular posterior teeth presented a distal or posterior cusp relation to the maxillary molars.

To break this habit I tried psychologic methods by appealing to her pride and will power, by showing her photographs of extreme facial deformities and by letting her understand that she would look this way if the habit continued. I had the parents take away certain playthings that she cared for most, and refused her candy, etc.; but all this was to no avail, since the child was contented with her lip to the exclusion of everything else. Finally I constructed a lingual wire running from the maxillary right deciduous canine to the maxillary left deciduous canine with five sharply pointed spurs soldered to the bar in such a manner that it would stick her lower lip when sucked. This cured the habit, though it took three months.

Tongue-sucking, which is very infrequently found, permits the elongation of the posterior teeth causing an open-bite in the anterior teeth.

Herbst's *Zahnasztl Orthopodie* mentions the use of pacifiers during infancy, the sucking of the cheeks, and the biting of the upper lip as probable influences in mesioclusion of the mandibular arch.

The habit of pushing the mandible forward was suggested by the late Dr. Calvin S. Case as one of the causes of mesioclusion and that hypertrophy of the tonsils frequently stands in causal relation to them.

As early as 1825 Dr. Joseph Sigmond in his book on "Practical and Domestic Treatise of the Diseases and Irregularities of the Teeth and Gums With Method of Treatment," mentions the pushing of the mandible forward, with its growth into a determined habit, as being a cause of mesioclusion. Peckert has suggested the biting of cigar tips as practiced by cigar smokers as a prominent cause; Palltorf suggests the biting of threads among seamstresses as another cause.

Some writers have mentioned mouth-breathing as a habit, but this is usually the result of obstructed nasal respiration, such as hypertrophy of adenoid and tonsillar tissue, deflected septum, nasal spurs and polypi. Therefore, mouth breathing could not be classed as a habit which causes malocclusion, it being a secondary and not a primary etiologic factor. However, after all obstructions of nasal respiration have been removed, some patients continue breathing through the mouth from force of habit, and it is necessary to correct this if we expect the prognosis of our orthodontic treatment to be favorable and permanent.

Herbst, I believe, was the first to mention the extraoral habits, such as resting the hand upon the chin and sleeping on one side. These habits he believed caused extraoral pressure which in turn caused malformation of the jaws and processes which would naturally result in malocclusions.

Dr. Harvey Stallard of San Diego, Calif., in his paper, "A Consideration of Extraoral Pressures in the Etiology of Malocclusions," which was read before the New York Society of Orthodontists, October 14, 1929, and published in the May, 1930, issue of the INTERNATIONAL JOURNAL OF ORTHODONTIA, ORAL SURGERY AND RADIOGRAPHY, gave quite a lengthy and well illustrated

article on extraoral posture habits which cause extraoral pressure while awake, such as resting the closed hand against one side of the cheek, the open hand against one side of the face, resting both hands closed under the chin and against the cheeks. Resting one hand partly closed under the anterior teeth, he states, is the probable cause of such type case as distoclusion with linguoversion of the maxillary anterior teeth and a deep overbite. The postures illustrated in his article showing these types are certainly anything but comfortable, and I cannot agree with him in the least on this particular habit, since I do not believe any mentally sound human being would assume and remain in such an uncomfortable and tiring position for so long a period, each day through several weeks, as would be required to establish such a deformity. I admit extraoral pressure may cause deformities and malocclusion if practiced long enough each day over a period of several months.

Further on in his paper Dr. Stallard shows numerous sleeping postures to which he attributes the causes of all classes of malocclusions. His illustrations and explanations of these are very convincing, and no doubt the habits would produce the malocclusions he describes if the sleeping habits were practiced continually throughout the night over a period of years. Later Dr. Stallard shows several photographs of children presenting a typical posterior occlusion with labioversion of the maxillary anterior teeth in which he states that the cranium development suggests that the children seldom ever slept on their backs.

After reading this paper, I became deeply interested in this subject. Having three children of my own, ages three, seven and nine years, I decided to watch them while asleep. Very much to my surprise I found that they never remained in one position long enough to cause such deformity as shown by Dr. Stallard. Later I read the report of a test on babies made by Dr. H. M. Johnson, Marion M. Jacobsen and Carlyle F. Jacobsen of the Mellon Institute of the University of Pittsburgh. These babies who performed sleeping tricks for science lived in Chicago and were sons and daughters of college professors. "It has been shown," their report said, "that the afternoon nap does not tend to retard or shorten the sleep of the night or to render it more restless. So that if a child is judged to be in need of more rest than it is getting, the ideal way of gaining it is by means of the afternoon nap. The stay in bed at night is quite a circuit. From sixty to eighty times a night the youngster will change his sleeping posture; this is twice as often as an adult shifts. The theory that a young child may acquire a deformity, the scientists find, or develop a beautiful figure by lying for long in some bodily position that he habitually prefers, has been rendered very doubtful by the testimony of the motion picture camera."

In one of our local newspapers dated February 26, 1931, there was a full-page advertisement on Simmon's Beautyrest mattresses which stated in huge print: "We sleep ten to fifteen different ways each night. Science has now proved that we sleep in ten or more different positions and change from one to another twenty to forty-five times each night for complete refreshment. It has proved that we 'rest in parts.' Any one position shortly becomes a bad

position, cramping some of the muscles and organs. No one sleeps without turning over all night, unless drugged. Automatic motion picture cameras have recorded sleeping habits in a series of revolutionary experiments carried on by Dr. H. M. Johnson and a staff of scientists at Mellon Institute, Pittsburgh. The positions taken during sleep have been observed. The time spent in each position has been measured. Out of this important study has come a new knowledge of sleeping equipment."

The report of the Mellon Institute, along with personal observations of my own children, has convinced me that sleeping habits are not practiced a sufficient number of hours during the night to cause such deformities as shown by Dr. Stallard.

In conclusion I wish to state that I think anyone diagnosing a case of malocclusion should spend just as much time and effort in studying the habits of the individual as he does in classifying the case and outlining his plan of treatment, inasmuch as this is of major importance in a favorable, permanent prognosis.

A BRIEF REVIEW OF THE DEVELOPMENT AND GROWTH OF THE HUMAN JAWS AND TEETH*

By Stephen A. Moore, D.D.S., London, Ont., Canada

IT WAS not until some time after I had started this paper that I realized the extent of the work covered by the title. There seems to be no limit to the number of papers and books published dealing with this subject, and the difference in opinion of the various investigators and writers is as great as the publications are numerous.

I claim no originality for any of the statements but have endeavored to follow the recognized authorities and in different places have quoted statements made by them. In the section dealing with the development of the mandible and maxilla, I have followed the teaching of Fawcett principally. In that portion dealing with the development of the teeth, Noyes and Bodecker are quoted freely.

Originally I had intended to go more minutely into the different phases of the subject, especially the growth of the jaws and the work done by Brash with madder feeding. This subject, however, would cover a paper in itself.

THE MANDIBLE

The mandible is the second bone in the human embryo to start ossification. It is preceded by the clavicle. The mandible is developed in the first visceral arch, and the first signs of ossification occur at about the fourth week of fetal life. The fetus at this time is in the 17-18 mm. stage (C.R.). In the preossification stage, there are three rod-like pieces of tissue lying more or less side by side being, from within outward, Meckel's cartilage, the inferior dental nerve and some dense cellular tissue from which the mandible will later be formed. In the mesenchyme, near Meckel's cartilage and the developing tooth germs, delicate fibers appear, along which the connective tissue cells arrange themselves, gradually taking on the form of osteoblasts. These cells lay down bone, gradually extending through the mesenchyme and surrounding Meckel's cartilage. This cartilage is closely associated with the development of the mandible and probably acts more or less as a framework in the development of the bone.

Bone first makes its appearance in that cellular tissue which lies between the incisor and the mental branches of the inferior dental nerve. This bone develops in membrane and grows rapidly backward under the mental nerve so that this nerve lies on the bone in more or less of a groove. A further change takes place in the formation of the internal alveolar wall by an inbending of the anterior border of the mental groove beneath the incisor nerve. At the same time, a hook-like process grows backward from the anterior border of the mental groove over the top of the mental nerve and fuses with the posterior side of the mental groove to form the mental foramen. This occurs at about the end of the 19 mm. stage. The incisor nerve at this stage is lying in

*Paper presented before the American Board of Orthodontia.

more or less of a bony groove, and the next development is the growth of the bone so that the groove is bridged across, forming the incisive canal, the first nerve canal to be developed in the mandible. Later on at about the 60 mm. stage, the inferior dental canal is developed in a similar manner, that is, by a bridge of bone which forms between the inner and outer alveolar walls over the top of the inferior dental nerve.

At about the 30 mm. stage, there develops from the upper border of the mandible, near the posterior end, the coronoid process. Later the growth of this process is supplemented by a strip of cartilage which is not derived from Meckel's cartilage. This cartilage makes its appearance at about the 80 mm. stage and is ossified by invasion of osteoblasts from the neighboring bone upon which it rests. The coronoid process is, therefore, formed from both membranous and cartilaginous bone, and some investigators state that before the cartilage is completely ossified, growth may take place similar to that in the long bones.

At a later stage two shelf-like projections of bone grow laterally toward the median line from the mandible, one above Meckel's cartilage and one below, which in time fuse on the inner surface and enclose the cartilage from the region of the second deciduous molar to the anterior end of the mandible. The cartilage is not converted into bone but undergoes resorption, although some investigators claim that in the region of the symphysis the cartilage undergoes ossification to form part of the mandible lying between the mental foramen and the symphysis. There is also a difference of opinion as to whether or not Meckel's cartilage is actually enclosed in bone or just lies in a deep groove. This may vary in embryos and the difference of opinion on this point does not alter the basic principle of development.

At about the 50 mm. stage, a mass of cartilage makes its appearance in the region of the future condyle. It has a carrot-like form whose small end tapers away in the region of the foot of the coronoid process. This cartilage is not connected with Meckel's cartilage and begins to ossify almost immediately by invasion of the osteoblasts from the bone which surrounds it, so that the condyle is formed from membranous and cartilaginous bone similar to the coronoid process.

At the 100 mm. stage, a strip of cartilage makes its appearance at the symphyseal end of the mandible and is continued along the upper edge of the inner and outer alveolar walls. These are accessory cartilages and are not ossified independently.

From the above, it will be seen that three different elements enter into the development of the mandible, namely, membrane, Meckel's cartilage and the accessory cartilages. Ossification first begins in the membranous tissue and invades the other elements, and Meckel's cartilage seems to act as a temporary framework upon which the mandible is modeled or developed.

THE MAXILLA

The maxilla starts to ossify in the maxillary process of the embryonic face after the mandible and is therefore the third bone in the human embryo to start ossification. In the adult, the maxilla is really a combination of the

maxilla proper, the premaxilla and the prevomer. Generally, ossification starts first in the maxilla proper in the membrane opposite the canine tooth germ at about the 18 mm. stage. At this time the stomodeum is one cavity, and it is by the development of the maxilla and the associated tissues that it is divided into the oral and nasal cavities. After ossification has started the progress of growth is rapid. The bone has a splint-like appearance with the convexity inward, which indicates the spot from which the palatine process develops inward to form the hard palate.

At about the 19 mm. stage, the frontal process can be traced with some of the orbital surface which continues to the malar process. The orbital surface is perforated by the anterior dental nerve which runs downward and inward through the maxilla below the level of the palatine process to the outer alveolar wall. Near the 27 mm. stage, a mass of cartilage appears in the region of the malar process and rapidly undergoes ossification. The palatine process also develops rapidly, thickens and grows backward and inward. At the 30 mm. stage, the infraorbital groove may be seen with the infraorbital nerve in it. This may later fuse over but often, even in adults, remains a fissure. Throughout the development of the maxilla, the nasal cartilaginous capsule seems to act more or less as a support scaffolding and may possibly be compared with Meckel's cartilage in the mandible.

At about the 100 mm. stage, the paranasal process joins the maxilla and becomes ossified, and at about the fourth month the maxillary antrum starts formation on the medial wall above the palatine process. This cavity gradually develops separating the orbital and buccal surfaces of the bone and increasing the height of the maxilla. However, the separation may be very small even at birth but gradually increases with the eruption of the teeth.

The premaxilla may start ossification before the maxilla but not as a rule. It is that part of an adult maxilla which contains the incisor teeth. It starts ossification in front of the anterior dental nerve over the incisor tooth germs and grows in an upward direction to form part of the nasal process. It also extends backward over the incisor tooth germs forming the posterior alveolar wall and forms that portion of the maxilla anterior to the anterior palatine foramen. It joins the maxilla proper at about the 30 mm. stage. It is the failure of union of these bones that causes cleft palate. In some instances, this condition has been found to be present between the central and lateral incisors which would lead one to think that the premaxillary element may be developed from two centers of ossification. Cunningham makes this statement and quotes both Albrecht and Warinski as supporting this view. Brash states that two processes separated by mucous membrane are extended backward over the incisor tooth germs and have a wedge-like appearance separated by a fissure. Schaeffer[7] states: "In this connection one must clearly keep in mind that cleft palate is due not to a failure of osseous centers to coalesce but to the nonunion of preosseous mesenchymal bars or processes. It is also important to note that the rudiment of the lateral incisor tooth is formed near the field of fusion of the medial nasal and maxillary processes, and in the event that the coalescence fails of consummation the

lateral incisor rudiment may be carried away by either the maxillary or the premaxillary element in their further and subsequent separation incident to growth and stresses, so the tooth may be stranded in the gap between them. This accounts for the variability in the location of the lateral incisor in cleft palates (in the maxilla proper, in the premaxilla or between them). It should also be noted that occasionally the palatal portion of the premaxilla is made up of two processes in the preosseous stage, one corresponding to the medial incisor rudiment and the other to the lateral incisor. This apparently explains some of the clefts between the medial and the lateral incisors."

At about the 50 mm. stage, there appears to be another center of ossification on the medial side of the paraseptal cartilage. This is also called the prevomer center. By about the sixth month the three bones, namely, the premaxilla, the prevomer and the maxilla proper, are so united that it is difficult to recognize the independent character of their origin. The number of centers of ossification is not certain owing possibly to their early fusion, but Cunningham describes five centers, an external or malar, an inner or orbitonasal, a palatine, a nasal and an incisive center. From the above it will be seen that the maxilla is formed principally in membrane but has accessory cartilages, especially in the malar region.

THE TEETH

The first sign of the development of the teeth occurs about the sixth week of fetal life and is first noticed by a thickening of the epiblastic cells on the crest of each arch in the area which will later be occupied by the teeth. The process of development may be divided into four stages: (1) the dental ridge; (2) the dental groove; (3) the dental lamina; (4) the enamel organ.

The multiplication of the cells of the epithelium forms the dental ridge, and at the same time a depression is caused in the mesoderm by a proliferation of the epiblastic cells. This burrowing results in the formation of a groove on the lingual side of the dental ridge called the dental groove. From the lingual side of the dental ridge, embedded in the mesoderm, the cells of the Malpighian layer develop lingually at approximately right angles to form a continuous shelf called the dental lamina. From ten points on the lamina corresponding to the deciduous teeth, buds of epiblastic tissue grow deeper into the mesoderm taking the form of tubular glands. These develop and become bulbous and later more or less bell-shaped. This is called the enamel organ. At this stage the enamel organ consists of an outer layer of columnar cells continuous with the dental lamina and a central mass of large polyhedral cells and is connected with the dental lamina by an epithelial cord. The polyhedral cells later take on a peculiar appearance from which they get the name stellate reticulum. At about the same time, the cells of the mesoderm under the enamel organ start to proliferate and grow up inside the enamel organ. These cells form the dental papilla, which later forms the dentin of the tooth. The tooth germ at this time is composed of the enamel organ consisting of an inner and outer tunic, the stellate reticulum and the dental papilla. From the base of the papilla fibrous tissue develops which encloses the tooth germ in a definite sac. This is called the dental follicle. The

above changes take place from about the sixth to the sixteenth week, at which time the calcification of the dentin and enamel starts. At this time the epithelial cord is severed, and the outer tunic of the enamel organ is broken, forming the stratum intermedium. At about the same time the formation of the bud of the successional tooth is started.

About the sixteenth week, all the germs of the deciduous teeth have been enclosed in their follicles, and the formation of the enamel organ of the corresponding permanent teeth has been started. The cells of the outer layer of the dental papilla are called odontoblasts and form the dentin of the tooth building from without inward, starting slightly before the enamel formation is commenced. The cells of the inner surface of the enamel organ are called ameloblasts and form the enamel of the tooth building from within outward. As soon as a few layers of dentin have been laid down by the odontoblasts, the ameloblasts commence laying down enamel on the dentin. The line of contact between the ameloblasts and the odontoblasts will later become the dento-enamel junction. The formation of enamel and dentin begins at different points more or less close to each other, but as the dental papilla develops, these points become farther apart until the shape of the tooth is reached and the different developmental points grow or coalesce with each other. The growth of the papilla then ceases.

There is some disagreement as to the origin of the enamel organ of the permanent teeth succeeding the deciduous teeth. Some investigators claim that it arises from the outer tunic of the enamel organ of the deciduous tooth, others that it comes from the cord connecting the outer tunic with the surface epithelium, and still others claim that it arises from the dental lamina direct. This point is not of great importance, and in any case the development proceeds along a line similar to that of the deciduous teeth.

The enamel organ of the first permanent molar is derived directly from the dental lamina and is the only permanent tooth to have this origin. At about the seventeenth week, a bud is given off from the dental lamina which grows into the mesoderm and develops into the enamel organ of the first permanent molar, and by the ninth month the follicle is complete and calcification has started.

The enamel organ of the second permanent molar is formed from a bud given off from the outer tunic of the first permanent molar at about the third month after birth, and the third permanent molar is formed from a similar bud given off from the second permanent molar at about the third year. The further development into the enamel organ and tooth germ is similar to that described in the case of the deciduous teeth.

GROWTH OF JAWS AND ERUPTION OF TEETH

At birth, the jaws contain all the deciduous teeth and the first permanent molars in a partially formed condition, and the follicles of all the permanent teeth with the exception of the second and third permanent molars, in all, parts of forty-four teeth. At this time the mandible is nearly straight, but as the bone grows and the teeth erupt, the ramus develops at an obtuse angle to the horizontal portion of the mandible.

One of the factors governing the growth of the mandible and maxilla is the functional or mechanical demands put upon it. Subperiosteal bone is laid down and changed into Haversian system bone which forms the compact bone of the surface. When this bone reaches a certain thickness, absorption takes place in the deeper portions, and this bone is changed into cancellous bone. The reverse of this phenomenon may also occur. In fact there appears to be a definite relation between the growth of the bone and the mechanical (or functional) forces to which it is subjected. In other words a bone develops so as to perform the duties incident to its normal function. A bone may develop under certain forces, and if these forces are removed, absorption may take place, so it would appear that there is a delicate arrangement between the requirement or physiologic use of a bone and its size and shape. The size and shape of a bone are gradually brought about by a building on and an absorption of bone so that the resultant form is that best suited to perform its functional duties.

At certain periods the growth of the jaws appears to be more rapid than at others. These periods seem to have a definite relation to the eruption of the teeth. The first period is from shortly after birth until about two years of age which corresponds to the eruption of the deciduous teeth. The second period starts previously to the eruption of the first permanent molar so that the jaws may accommodate the larger permanent teeth, and a third period seems to develop the jaws for the eruption of the second permanent molars. There may also be a further period at the time previous to the eruption of the third permanent molars in order to have space to accommodate these teeth.

There is no doubt that the growing tooth germs produce a force which helps to develop the jaws. This force is produced by a multiplication of the cells of the tooth germ, and is only one of the many forces which assist in the development of the jaws. The muscular force as exerted by the different muscles, including the tongue, lips and associated tissues, is very important, and it is also very important that these forces be normal for normal growth and development. The functions of speech, mastication, deglutition and respiration create certain stimuli to which the developing jaws respond.

Noyes states: "In all the process of development the growth is the result of all forces to which the bones are subjected, perfectly distributed through the substance of the bone by the agency of normal occlusion." The forces of occlusion have been defined as those factors which when acting normally cause teeth to assume and maintain their position in the line of occlusion. These forces have been divided into the following groups: (1) normal cell metabolism; (2) muscular pressure; (3) force of the incline planes; (4) harmony in the size of the arches; (5) normal proximal contact; (6) atmospheric pressure.

Should these forces be acting normally, the development of the jaws and teeth should proceed normally (assuming other factors are normal); but should one or more of the forces be abnormal, the result will probably be a maldevelopment of the jaws or a malocclusion of the teeth, or both.

At about the seventh month after birth, the mandibular central incisors of the deciduous dentition break through their crypts and erupt. At this time the root is not fully developed and has a funnel-like end. These teeth move occlusally, probably due to the multiplication of the cells at the root end and the blood pressure. Cementum is formed on the surface of the root, and the bone of the wall of the crypt becomes the alveolus of the tooth from which connective tissue fibers run to the cementum of the tooth to form the beginning of the peridental membrane. As the tooth proceeds occlusally, bone grows around it forming the alveolar process. This results in a considerable growth to the face of the child in a vertical direction and a corresponding increase in the length of the ramus. This same procedure is carried out with the remainder of the teeth of the deciduous dentition until all have erupted and are in their normal positions. This occurs about three years after birth.

At about six years of age, the first permanent molar erupts posterior to the deciduous second molar. This tooth succeeds no tooth and is succeeded by no tooth and is the tooth used principally in mastication during the important childhood period from six to twelve years when the deciduous teeth are being shed and replaced by the teeth of the permanent dentition. They are also very important from the standpoint that their cusp digitation often decides the relation in which the remainder of the teeth of the permanent dentition will meet. In fact, their abnormal eruption or loss may decide whether the remainder of the teeth will be in a normal relation or in malocclusion. It is not the purpose of this paper to discuss particularly the first permanent molar, but it is doubtful if its importance can be exaggerated.

Shortly after the eruption of the first permanent molar, the mandibular central incisors of the deciduous dentition are generally shed, the first of the deciduous teeth to be lost. They are succeeded by the mandibular permanent incisors which erupt very shortly after the deciduous teeth have been shed. There has been considerable written regarding the resorption of the roots of the deciduous teeth and the manner in which it occurs, and different theories have been advanced by different investigators. Thomas states: "It seems strongly evident that osteoclasts or their endothelial predecessors are the active agents of absorption, although the method by which they accomplish it is unknown." The permanent incisors have a larger mesiodistal diameter than the deciduous incisors, and as they erupt they tend to exert a force on the lateral incisors thereby helping to develop the mandible. Northcroft does not believe that teeth are responsible for jaw growth, and states: "To make the teeth responsible for the growth of the jaws is an idea that should be discarded. In recent years the tendency has been to abandon the mechanical theory of growth and to concede adaptation to function to be the all important factor, and conversely that the lack of function arrests growth. The effects of environment must not be entirely overlooked nor that development depends upon conditions under which it takes place." To me it would appear that growth may take place in response to certain stimuli, and the growth factor probably does not differentiate between the stimuli as to whether the source was from function or the eruption of teeth.

Shortly after the mandibular deciduous central incisors are lost, the maxillary deciduous central incisors are shed and succeeded by the permanent teeth. This process continues until all the deciduous teeth are shed, which is generally at about twelve years of age, the last teeth to be lost being the maxillary second deciduous molars. As a rule the succeeding teeth are larger than the deciduous teeth with the exception of the second premolar which is smaller than the second deciduous molar, the tooth which it succeeds. The importance of the second deciduous molar in relation to normal occlusion is often overlooked. Should this tooth be lost prematurely, there is a marked tendency for the first permanent molar to move forward and occupy some of the space that would be occupied later by the second premolar. This will result in either an impacted second premolar or the premolar erupting on the buccal or lingual surface.

At about twelve years of age, the second permanent molars erupt. Previous to this, in order to accommodate them, there has been a lengthening of the arches due to a growth in an anteroposterior direction, and at about eighteen years of age, the third permanent molars erupt if in normal condition. These teeth are often missing and in many other individuals remain impacted, or are removed by surgical means.

We are all more or less familiar with the changes in the face and jaws of a human being from birth to adult life, and I have no intention of entering into a discussion as to how these changes take place. Whether these changes are caused by an interstitial bone growth or balance between the deposition and absorption according to functional demands, or a combination of both, is a debatable subject. Each theory has its own proponents. Tomes states: "That the growth of the jaws is essentially an addition to the posterior portion to make room for the eruption of the permanent molars. If all the bone ever formed were to remain, the coronoid process would extend from the condyle to the region of the first bicuspid." Noyes does not agree with this and states: "Conditions are more correctly stated by saying that forces exerted at the posterior portions of the jaws through the development of successive molars, cause the bone to grow downward, forward and outward in the upper arch and upward, forward and outward in the lower arch, carrying the bone into an entirely new position in space."

At the present time, there is a great deal of work being done on bone growth, and many papers are being published, but there is no agreement on many important phases of the subject. Brash in his earlier investigations with madder feeding did not believe that interstitial bone growth in the mandible could take place, but his later writings look upon this phenomenon more favorably. This is a very important subject from the standpoint of the orthodontist, and it is to be hoped that present investigations will result in an unanimity of opinion.

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THE TREND OF ORTHODONTIA*

By Harry L. Hosmer, D.D.S., Detroit, Mich.

A STUDY of the trend of the science of orthodontia throughout the past decade and a half brings one to the realization that one is engaged in a work that permits of no abatement in one's efforts to keep abreast with the constantly increasing abundance of knowledge.

So vast is the field of this knowledge, that one is carried far beyond the comparatively simple mechanics of tooth movement and deeply into the science of biology, there to be confronted with almost limitless study and research.

There are many indications that orthodontia is going through a transitory period, which in the next ten or fifteen years will mark a new epoch equally as interesting as that of the past fifteen years. During this time the science and art of orthodontia have begun to evolve from a chaotic speculation into something definite.

When we consider that many of the factors which produce malocclusion are not of local origin, and that the mouth is only one point of existing insufficiencies, we must turn our attention to the predisposing causes.

Here we find that metabolism and the glands of internal secretion are but two of the biologic factors; the imbalance of which may be manifested in anomalies of the teeth and surrounding structures.

The work already done in these two subjects bids fair to reveal the cause of many failures that lie buried in the orthodontic graveyards.

For many years orthodontia was considered in the sense of applying such apparatus as to force teeth to move into position, without any knowledge of the phenomena occurring in the bone to make such movement possible. Together with this, the treatment of malocclusion was regarded as a problem of setting tooth forms into a curve of reasonable symmetry from a morphologic standpoint without regard for those details which inevitably would make for failure or ultimate recurrence. The present basis of orthodontia has destroyed these thoughts, and it is now regarded as a physiologic and a functional process.

In order to base orthodontia physiologically, our first element of reasoning must be founded on the living cell. As in all forms of organic matter, the first essential in growth and development relates to the individual cell. The exact extent of growth development of any living object depends upon the physical condition of the cells which constitute its make-up as regulated by those many agencies contributing to the well-being of the cellular organism.

This being true, it is but logical to assume that the diet of the mother during pregnancy as well as the diet of the infant after birth will have a marked bearing on the cells of specialization.

*Paper presented before the American Board of Orthodontia.

We know that the tooth buds are distinguishable as early as the eighth week of prenatal life, and shortly thereafter the enamel organs appear. Calcification of the deciduous teeth is well on its way at birth as is also that of the first permanent molars. Any agency that adversely effects the development of the teeth during this time will manifest itself later.

Investigators thus far have shown us that much assistance can be had from proper diet. How far its effect can be carried both in prevention and in treatment, only time can tell. Surely in the light of our present knowledge and the constantly increasing education of the laity in such matters, the children of the future will profit thereby.

It has been known for sometime that synthetically pure diets containing the correct quantities and proportions of the proximal constituents of food produce certain diseases. Lack of fresh milk produces rickets, polished rice gives rise to beriberi, deficiency of fresh green vegetables causes scurvy. These diseases are cured when the correct food is taken. In other words a correct diet of all the necessary vitamins is essential to the growth of young animals.

Of the composition and nature of vitamins little is known. Their existence is inferred from their effect, and they are probably of the nature of enzymes.

This leads to the conclusion of definite enzymes, which are chemicals secreted by definite glands, producing special results in certain parts of the organism. These substances are now familiar as hormones, the products of endocrine organs of internal secretions or as commonly called, the ductless glands. These glands secrete the hormones into the blood, and they are sent to various parts of the body.

Thyroid secretion is one of the best known hormones and acts as an accelerator of metabolic rate. Insufficiency of thyroid in young animals results in stunted growth, abnormal proportions and lack of development of the brain. The administration of thyroid causes the resumption of growth and normal development.

The pituitary is another ductless gland whose secretion is responsible for the growth of the long bones and of certain others. Experiments in lower animals with pituitary extract shows a remarkable increase in growth.

As there are about a dozen ductless glands known, all intricately interrelated, it is probable that other glands besides the thyroid and the pituitary influence growth.

As our knowledge of the ductless glands increases, and hitherto unknown ones are discovered, who knows but that we may be treating orthodontic cases by hypodermic.

How futile it is for us to attempt to treat mechanically, those cases of malocclusion whose origin is not in the mouth. And how necessary it is that we collaborate with the pediatrician, endocrinologist and other specialists of medicine. Today we are looking to these men for the answer to many problems which have baffled us in the past.

Systematic muscular exercise is another valuable adjunct in the treat-

ment of malocclusion. Rogers and others have demonstrated beyond dispute that functional activity brings about growth.

Most of the cases which come under our care are at the age of greatest activity in growth and development. At this time, if intelligent systematic exercise is incorporated into the treatment, the work will be facilitated to a surprising degree.

Furthermore, if it became general practice to include exercise with mechanical treatment, many orthodontists would learn by experience the true meaning of physiologic and functional growth.

Notwithstanding the many ramifications in the science of orthodontia, it is essentially mechanical, and always will be. Therefore, no discourse on the trend of orthodontia would be complete without mentioning the advancements made in the construction of orthodontic appliances.

With the advent of the lingual appliance, a new standard of treatment was born which was destined to be a boon to the specialty of orthodontia. As more of the profession adopted this type of appliance, more variations appeared. The delicate auxiliary springs replaced the wire ligatures; suggestive stimulation replaced the forceful and sometimes painful method of pulling teeth into alignment.

The lingual appliance could be quickly removed and cleaned; it caused no irritation of the soft tissues, and from a hygienic standpoint it was a great step forward. Prior to the general adoption of this appliance many dentists hesitated to refer cases of malocclusion for treatment, believing that the results accomplished did not justify the loss of tooth substance which usually occurred.

The coming of the lingual arch and other appliances which stimulated and directed the growth of teeth into position, also stimulated professional and public interest in the specialty of orthodontia. Young men are rapidly coming into the field and most communities now have at least one orthodontist.

Because of the general popularity of orthodontia, it is imperative that we guard carefully the high standards, which we as a specialty have always maintained. As the hidden knowledge is slowly but surely revealed to us, we shall need more skillful hands and keener minds than ever before.

A CONSIDERATION OF ORTHODONTIC ATTACHMENT*

By Bernard L. Hyams, D.D.S., Montreal, Canada

ORTHODONTIC appliances are devices employed for correcting malocclusions of the teeth. Two separate factors enter into the constitution of an appliance, namely, an agent to produce the applied force and some method to secure the attachment of the agent to the denture. In a previous paper[5] the important features connected with the employment of agents for the application of force in orthodontia were considered. In this work a consideration of the complementary field of orthodontic attachment is undertaken. In its scope are included the recognition of the principles that determine the design of the different devices for securing the attachment of the various agents for the application of force, and the recognition of the important biologic and mechanical factors that determine the relative merits of these devices.

Among the many methods of attachment that have been devised, several distinct types may be noted, that illustrate the working principles underlying all of them. These types are arranged progressively in the following order:

1. An attachment to the exposed tooth. (a) Simple point or line bearing, e.g., the contact of a finger spring, body wire, vulcanite retainer or an inclined plane. (b) Gripping the exposed tooth, e.g., an encircling ligature, or the clasp of a removable appliance.

2. An attachment consisting of a cemented band and an associated attachment. (a) A cleat to hold a ligature or a spring securely, e.g., a soldered spur. (b) A loop cleat to hold a ligature or a spring more securely, e.g., a loop spur, a round tube, a half-round tube, a bracket with lock pin. (c) A labial or buccal type of attachment introduced expressly to eliminate the need of penetrating the interproximal embrasures by ligatures, e.g., a round tube, a half-round tube, an open tube with spur attachment. (d) A direct type of attachment to facilitate manipulation, e.g., a pin and loop attachment; a round pin and tube attachment; a half-round pin and tube attachment; an open tube and arch attachment. (e) A direct type of attachment introduced for the absolute control of the applied force, e.g., a half-round pin and half-round tube with individual lock; a horizontal or vertical bracket with accurately fitted arch and lock pin.

When an attachment is employed in different situations in the denture, it often undergoes modification to comply with the special requirements for each situation. A distinction may thus be drawn between terminal attachments and intermediate attachments.

Terminal attachments are adapted for use on the molars, which generally mark the limits to which an appliance extends.

Intermediate attachments are adapted for use on the teeth intervening between the molars, being generally contained within the limits to which an appliance extends.

*A part of the work required by the American Board of Orthodontia.

COMPILATION OF A CRITIQUE OF ATTACHMENT

The manner in which an attachment conforms with biologic dictates and its regard for the economy of the time and effort of the operator are the standards that determine its relative merit for employment in practice. The factors that constitute these considerations therefore provide a suitable basis for the critical examination of every type of attachment. The following part of this work is devoted to the compilation of this critique of orthodontic attachment.

The term compatibility may aptly be applied to the first consideration, and the term efficiency to the second.

Compatibility includes the biologic and allied factors involved in attachment, while efficiency includes the mechanical and technical factors.

Three principal factors cover the scope of compatibility: (1) The first factor comprises the effects on the internal tissues of the denture, of the different types of anchorage, displacement and fixation of the teeth that are induced by the different types of attachments. (2) The next factor comprises the effects on the oral tissues or external tissues of the denture of introducing the different types of attachments. (3) The last factor comprises the hygienic properties of the various materials that enter into the formation of the attachments.

The precise nature of each of these factors must be made clear.

1. Although the (a) anchorage, (b) displacements, and (c) fixation of teeth differ mechanically, they must be considered together in the division of compatibility, because in application they are very closely interrelated in their biologic aspects.

a. The fundamental types of anchorage are simple and stationary anchorage. Because of a particular biologic reaction, the resistance to displacement attained by a tooth through the medium of stationary anchorage considerably exceeds that attained through simple anchorage.[3] In altering the form of the denture, stationary anchorage is frequently employed to stabilize selected teeth on this account.

b. The fundamental types of displacement are tipping displacement and bodily displacement. In the use of appliances, tipping displacement generally proceeds from the application of force through the medium of simple anchorage, and bodily displacement from the application of force through the medium of stationary anchorage.

Many malocclusions indicate a deficient development in the basic regions of the denture. Successful regulation of such cases requires the development of these specific regions. Bodily displacement is frequently employed with that sole object in view. Lundstrom has examined the effectiveness of appliances that induce tipping and bodily displacement, for promoting growth of bone in the basic structures of the denture, in such cases as these.[7] From his findings he concludes that bodily displacement manifests no decided advantage, for the achievement of that particular result.

c. The fundamental types of fixation are mobile attachment and rigid at-

tachment. Mobile attachment induces simple anchorage and tipping displacement, while rigid attachment induces stationary anchorage and bodily displacement. Ketcham[6] has made a study of the effects on the internal tissues of the denture of the action of different types of appliances. He reports a high percentage of apical root resorption of the permanent teeth, in cases where the teeth were subjected to the action of those appliances that exercised rigid attachment. In the same study, such resorption was rarely observed where the teeth were subjected to the action of appliances that permitted mobile attachment.

The following conclusions summarize the context of this consideration. Simple anchorage, tipping displacement and mobile attachment conform satisfactorily with biologic requirements. Stationary anchorage, bodily displacement and rigid attachment, while possessing mechanical advantages, are biologically incompatible and their employment should be avoided, other means that conform with these essential biologic requirements being employed to secure their advantages.

2. The effects (a) on the crowns of the teeth, (b) on the gingival soft tissues, and (c) on the lips, cheeks and tongue of introducing an attachment in the mouth, form a consideration that approaches the biologic so closely that the reason for its inclusion in the division of compatibility is apparent.

a. The increased risk of damage by caries is the principal effect on the crowns of the teeth of introducing attachments in the mouth. The risk is increased by any interference with the prophylaxis of the teeth, either with the natural or with the applied measures.

Attachments that involve large contacts on the exposed surfaces of the teeth possess a marked disadvantage. This applies to flat wires, plate (retainer) bearing or loosened bands. Attachments that permit the lodgment of débris that cannot be removed readily also possess the same disadvantages.

b. Concerning the welfare of the gingival soft tissues, the chief effect of introducing attachments in the mouth is to cause trauma, due to the encroachment of foreign matter beyond the free margin of the gum. The adaptation and cementation of bands; the excursions of loosened bands; the passing of ligatures through the interproximal embrasures; the migration of ligatures from their original adjustments; and the irritant and septic qualities of the bands, cements and ligatures themselves, may all cause such trauma. An injury of this kind to the peridental membrane causes a permanent damage that opens the way for future trouble in the surrounding tissues. The serious nature of this consideration warrants due regard to its contributing factors.[1]

c. Irritation or injury, resulting from sharp projections, is the chief effect on the lips, cheeks and tongue, of introducing attachments in the mouth. The ends of ligatures, rough edges of bands, protruding tubes and other soldered parts, are sources of injury to these muscular tissues in their natural free play, during the performance of their function.

3. The protection of the individual from (a) the danger of introducing septic materials in the mouth, and the protection of the teeth from per-

manent injury by (b) caries or (c) staining, are involved in the consideration of the hygienic properties of the materials that form the various attachments. The reason for the inclusion of this consideration in the division of compatibility as one closely allied to the biologic is apparent.

a. Silk and rubber ligatures, and porous dental cements[4] absorb the oral secretions, and rapidly deteriorate with the result that an extremely insanitary condition ensues. This is due to the decomposition in the bacterial environment of the mouth. It is quite obvious that the retention of such matter in the mouth is a positive menace.

b. With regard to caries, certain base metal alloys and cements are understood to exert a deterrent influence on caries,[2] while gold and platinum materials are considered neutral in this respect. In the literature of orthodontia evidence is lacking of sufficient research being devoted to this important consideration, to enable definite conclusions to be drawn on this matter.

c. Copper and silver cements are liable permanently to disfigure a tooth by staining the enamel surface. As this is a serious matter, especially in regard to anterior teeth, precautions must be taken to avoid this contingency.

Five principal factors cover the scope of efficiency:

1. The degree of security attained by an attachment.
2. The control of the applied force secured by an attachment.
3. The expenditure of time and effort required for the initial adaptation of an attachment.
4. The amount of manipulation required for the adjustment of an attachment.
5. The durability of the materials that constitute an attachment.

As with the consideration of compatibility, the precise nature of each of these factors must be made clear.

1. The degree of security attained by an attachment may be gauged by its ability to resist displacement (a) through the stresses of mastication, (b) through the applied force of the agent, and (c) through interference at the hands of the patient.

a. The cements, banding materials, spring wires and soldered parts composing the attachments cannot withstand the great forces that are exerted by the muscles of mastication. If an attachment, therefore, must encroach on those surfaces of a tooth involved in occlusion, because of its design or proportions, it possesses an inherent disadvantage, with regard to the security of attachment attainable.

b. In order successfully to resist displacement, locks of either a natural or an artificial character must be provided to prevent the escape of the forces exerted by an agent in any direction in which they are applied. With a clasp on an exposed tooth, the constriction of the crown, gingivally to the contact point, provides a natural lock that checks dislodgment in the direction of the occlusal surface.

With the pin and tube attachment, dislodgment is checked in all directions save the occlusal whence the pin is inserted. Some locking device must therefore be employed to control this occlusal avenue.

1. With clasps, rubber ligatures and other types of attachments permitting of removal and replacement by the patient, excellent prophylaxis is provided. At the same time, the operator loses absolute control over the appliance, and occasionally this may interfere with his plans for regulation to such an extent that security of attachment is certainly not provided by them. In this respect, therefore, the fixed types of attachments may be considered more favorable.

2. The part played by an attachment in controlling the applied force of an agent refers to the range of displacement of individual teeth that may be achieved through the medium of the attachment employed. These displacements are axial tipping, axial rotation, and bodily displacement in the horizontal and vertical planes. The relative merit of an attachment from this point of view is determined by its ability to accomplish each displacement, as well as all possible combinations of these displacements at a single adjustment.

3. The initial adaptation of an attachment includes the construction of every part that enters into its formation. In the particular case of the pin and tube attachment, for example, this includes the formation of the band, soldering the tube to the band, cementing the band on the tooth, adapting the arch and soldering the pin in its correct relation to the tube, and attaching the locking device adopted. The bearing of this expenditure of time and effort on the selection of an attachment with regard to efficiency is obvious.

4. The adjustment of an appliance requires an expenditure of the time and effort of the operator, that varies accordingly to the readiness with which its attachments permit of such manipulation. In every adjustment of Angle's labial arch, for example, the ligatures must be removed and then replaced. Compared with the adjustment of a lingual arch fitted with Young-Angle locks, this is a tedious procedure. This factor assumes importance, therefore, in the selection of an attachment from the aspect of efficiency.

5. The durability of the materials forming an attachment directly affects the duration of a single adjustment of an appliance.

Rubber ligatures deteriorate quickly in the mouth, and accordingly must be replaced frequently. Silk ligatures assume an insanitary state quickly that also demands their frequent renewal. Base wire ligatures discolor in many mouths, and esthetics suggests their frequent replacement. Because of the decomposition of the oral secretions that are absorbed in porous dental cements, the removal of the bands at regular intervals is indicated in order to renew the cement. From these examples, it may be readily seen that the durability of its constituent materials influences directly the selection of an attachment from the aspect of efficiency.

Now in a treatise on orthodontic attachment, the cemented band must be accorded a prominent position, by reason of the essential and practically universal rôle it plays. Special attention to a vital consideration in regard to the application of bands, is therefore well merited. This consideration is the determination of the most favorable region of a tooth for the location of a band. The best way to simplify this matter is by recognizing the specific influences exerted by the several diverse factors that participate in the choice of the position.

1. *The Position That Affords the Greatest Mechanical Advantage.*—Bands are employed principally to provide an attachment that is secure from dislodgment. The security of a band from dislodgment through the stresses of mastication depends principally on the position the band occupies on a tooth. A position remote from the occlusal surface, where it is free from stress arising out of any movement of the teeth in mastication, is indicated as most favorable with respect to the security of attachment.

2. *The Position That Affords the Greatest Protection, and Is the Source of Least Additional Danger From Caries.*—Although a full crown preparation accomplishes this purpose best, it must be modified on account of technical, mechanical and esthetic considerations. A band must settle to position without requiring the trimming of the natural crown. The greatest circumference of a tooth is the region that offers the best adaptation on this account. To respect the greatest mechanical advantage, all the areas involved in occlusion must be eliminated. Esthetics indicates a position toward the gingival as the least conspicuous.

Finally, in the process of mastication, the teeth are mechanically cleaned at every bite. Any exposed surface, isolated from this flushing action, does not benefit from this natural prophylactic measure, a lodging place for débris actually being provided in its place. If the location of a band permits an exposed area to occur on the labial or buccal surfaces of a tooth, between its gingival limit and the gingival margin of a tooth, such a condition is created. This important point makes it imperative to extend a band clear to the gingival margin, on these surfaces.

3. *The Position That Is the Source of Minimum Irritation to the Gingival Tissues.*—The free margin of the gingival tissues is the limit to which a band should extend, adequately to respect this consideration. In the design of every band, rests should be provided, which limit the excursion of a loosened band into the gingival tissues.

In each particular case, the choice of the position of a band should represent the most advantageous compromise with regard to all these factors.

CONCLUSION

In the first stage of an orthodontist's career, the great problem is to obtain his results by any effective means whatever. After his devices have repeatedly proved their capability, the effectiveness of orthodontic measures is more or less taken for granted. The exacting orthodontist, having arrived at this later stage, endeavors to find methods for attaining his results that conform with the best interests of both patient and operator.

The aim of this work has been to enable the orthodontist both to criticize and to improve the methods he is accustomed to employ for the correction of malocclusions, in conformity with the best understanding of the times.

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DENTITION IN CLEFT PALATE CASES*

By H. L. D. Kirkham, M.D., F.A.C.S., Houston, Texas

It is patent that cleft palate, so gross a developmental deformity of the jaw, often involving as it does the alveolus, should be accompanied by malformations of various types and degrees of the dental elements; however, case analysis shows that the extent of dental defects is not in direct ratio to the maxillary deformity. Taking this as a premise it is at once obvious that while certain of the disturbances of dentition met with in these cases can be attributed to embryologic deficiency, some at least are due to other disturbing elements, and since a larger percentage of disturbed dentition occurs in cases following operations in which the jaw has been penetrated through surgical procedures, it is safe to infer that some of the problems confronting the orthodontist in cleft palate cases are a result of surgical intervention rather than embryologic deviation from the normal.

As the defect in the alveolus in complete palate clefts occurs at or near the lateral incisor, it is, therefore, obvious that this tooth shows more embryologic irregularity than all of the others. A study of the variations of the lateral incisors as seen in these cases brings out some very interesting data, true of only academic interest. These data may be of future value in helping to solve some of the problems of mechanism in the etiology of these deformities, which in turn may help to improve the practical side of palate repair.

The premaxilla is developed from the frontonasal process and in children's skulls and some adult skulls is seen to be composed of two portions on each side of the midline. (Fig. 1.) The mesial portions are known as the endognathion, the lateral portions as the mesognathion, and the maxilla proper being known as the exognathion. It has been taught for many years that the premaxilla bears four teeth, however, a study of cleft palate cases shows that this is seldom the case. The lateral incisor on the cleft side is often absent, and when present is more frequently placed on the exognathion rather than the mesognathion side of the cleft. This observation led Albrecht to the opinion that in cleft palate the cleft occurs, not between the mesognathion and exognathion, but rather between the mesognathion and endognathion, associated often with a deficient development of the mesognathion. Observance and study of a case of rare lateral cleft (Fig. 2) tends to bear this out, and also to bring to light additional theories on face development and the vagaries of the lateral incisors.

The case in question showed a bilateral cleft of the lip which extended lateral to the nasal ala with a cleft in bone or embryonic scarring which extended up to the orbit on both sides. On the left side the orbit was markedly

*Read at the Thirtieth Annual Meeting of the American Society of Orthodontists, St. Louis, Mo., April 20-24, 1931.

contracted with an atrophied blind globe; on the right side a globe showing corneal scarring and symblepharon was present. This globe is apparently blind, but may be remedied by iridectomy later.

In conjunction with the above, there exists a cleft palate which shows a bridging of tissue across the cleft in front, with a gap in the alveolus, and an extremely wide cleft with an apparent lack of palatal tissue. The premaxilla in this case is very interesting in that it contains four tooth buds, is much wider than the premaxilla in the average bilateral cleft palate and besides shows little or no forward displacement. This raises the question as to whether or not the mesognathion bearing the lateral incisor is so poorly

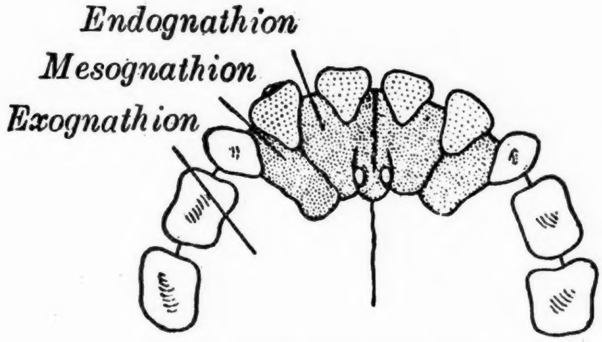


Fig. 1.—Premaxilla, after Albrecht.

Fig. 2.—Lateral cleft extending into both orbits.

developed or nondescended in bilateral clefts that the forward displacement of the premaxilla is an apparent rather than an actual forward displacement. Should this be true, it is obvious that it is incorrect to force the premaxilla back into the gap at operation, and as a matter of fact this is proved practically and seen in cases when this replacement has been accomplished by the action of lip muscle pull following repair of the lip over the gap. In these cases the arch is far more normal, to say nothing of preservation of dental structures. (Fig. 3.)

Keith in his very comprehensive studies on the mechanism of face growth states: "It is not necessary to go into all the reasons which have led us to regard the alveolar part of the maxillae, the part which lies below the level

of the hard palate and forms the bony socket of the teeth, as a distinct growth element, a plastic element regulated by its own independent system." Study of cleft palate cases shows that the alveolus though cleft, shows little or no growth disturbance except at the site of the cleft, namely the mesognathion; therefore there should be no special reason why dentition should be disturbed except in the lateral incisor area; unless we include such conditions as supernumerary teeth which, while more common in cleft cases are also seen in otherwise normal mouths and especially in the families of palate and lip clefts.

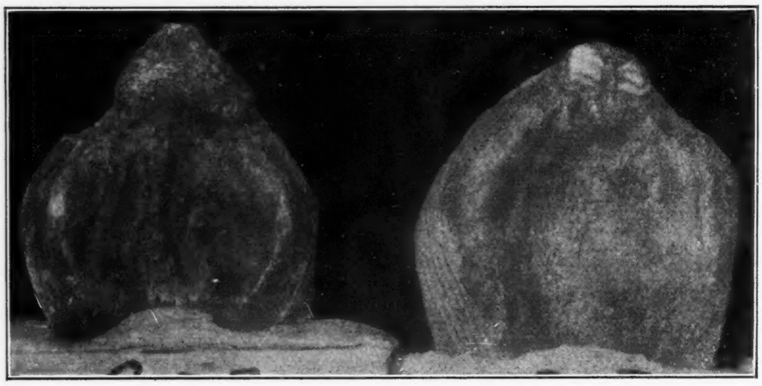


Fig. 3.—Double cleft palate before and after replacement of premaxilla by muscle pull.

Fig. 4.—Model of unoperated unilateral cleft palate in an adult showing good dentition except at site of cleft.

To determine the influence of palate clefts per se on dentition, it becomes necessary first to study the older cases upon whom no operation has been performed. In this study it is interesting to note that there is invariably no more disturbance in dentition than in the normal mouth of similar age, except as before stated in the region of the lateral incisor. (Fig. 4.) Another interesting observation is that caries is no more frequent in this nonoperative series in the maxilla than in the mandible, tending to show that clefts per se have no bearing or are not a causative factor of caries. (Fig. 5.) Whether lack of calcium or improper diet has a bearing on the causation of caries is a matter to be solved largely by the dentist and has no bearing here except as above stated that cleft palate does not appear to be a causative factor.

The study of this series further shows little or no disturbance of maxillary growth except that involving the mesognathion; which by comparison with the case of lateral cleft described earlier, probably is developed from the nasofrontal process and forms the alae of the nose and the nasal process of the maxillae, for in this case the cleft extends through the infraorbital canal which it must be remembered remains open into the floor of the orbit in the newborn infants.

A comparison of the above series with cases upon whom some sort of jaw penetration has been performed gives a totally different picture in regard to

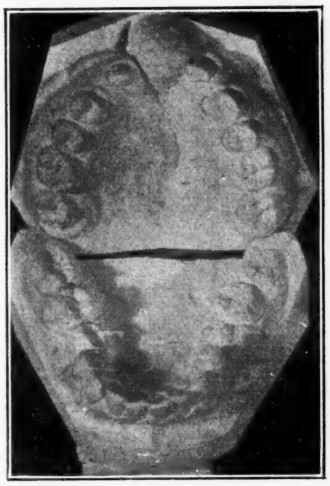
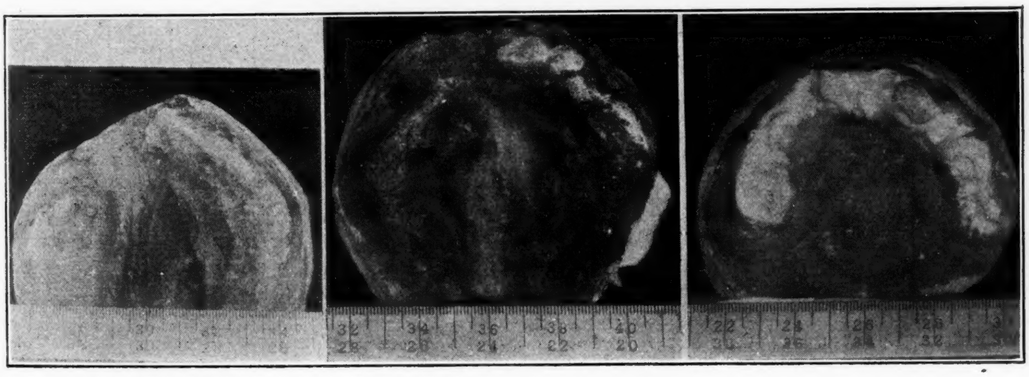


Fig. 5.—Models of maxilla and mandible in double lip and palate repaired without wires showing no lateral spread at tuberosities.



A. *B.* *C.*

Fig. 6.—Unilateral palate and lip repaired by wires. *A*, Before operation; *B*, immediately after operation; and *C*, eight years later; showing total lack of development of maxilla.

failure of development, caries, and misplacement of dental elements. The lack of development is more apparent in the alveolus than in the maxilla proper, and in some instances the alveolar growth has been completely arrested. (Fig. 6.) The cases which show such extreme growth disturbances are those in which the wire was known to have been placed too close to the alveolar border, thus cutting off the alveolus from the maxilla. Study of serial sections of a cleft palate case showed such extremely high position of tooth buds that it seems almost impossible to insert wires high enough to avoid injury

to these elements. The lack of development in the alveolus rather than in the maxilla bears out the statements of Keith, and further since the growth centers which largely influence the forward growth of the maxilla are situated in the sphenopterygoid region and along the vomer it would be difficult for wires to damage these centers seriously, therefore, the damage done by wires to development concerns the alveolus rather than the jaw proper, often because the wires are placed too low. However, should they be placed high enough to avoid growth disturbance the wires have a marked damaging effect on the tooth buds and dental elements.

Study of the groups of cases in which the wires did not effect alveolar growth shows that caries, absence, or misplacement of premolars and molars invariably occur. (Fig. 7.) Whenever caries of teeth in the maxillae occurs

Fig. 7.—Unilateral lip and palate repaired by wires, showing disturbed dentition.

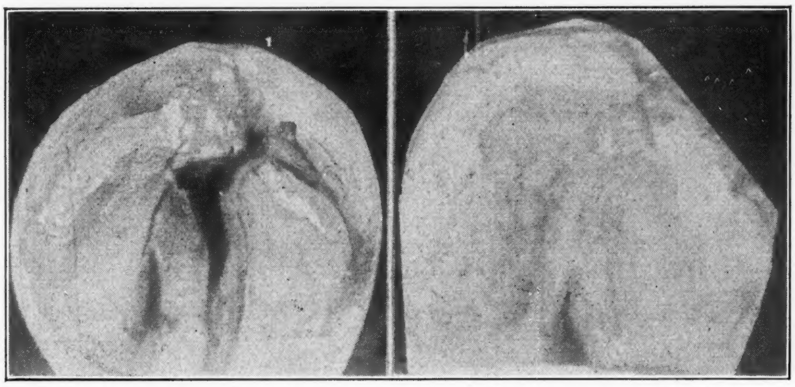
Fig. 8.—Occlusion in an incomplete cleft palate with a very wide cleft.

in such cases, it is seldom found that it exists in like ratio in the teeth of the mandible, demonstrating that the existing caries is a result of the damage done to the maxilla and its contained tooth buds.

If the results of cases upon whom some form of jaw penetration has been performed are compared with those which have had no penetration, we find a striking improvement in regard to the shape and form of the arch (Fig. 8), development of the maxilla, and still more improvement upon the existence of caries and misplaced teeth. The arch in these nonpenetrated cases more closely resembles the normal, and consequently occlusion, though naturally not perfect, is far better. (Fig. 9.) At the site of the lateral incisor we frequently find disturbances of development, but this exists without operation

and is attributable solely to the deformity. Regarding caries, or missing premolars and molars, we find little or no more irregularity than in the normal jaw of like age. Since so much more frequently the end-results are better when wires or some form of jaw penetration are not used, it is safe to infer that such operative measures are not alone unnecessary, but invariably cause damage of themselves. It is interesting to note that occlusion in the molar region is as good when no penetration has been performed as with it.

It can well be asked that if no wires penetrate the jaw what holds it or brings it into position? This is accomplished by the continuous action of the orbicularis oris muscle after repair of the cleft lip; and orthodontic experience with these cases immediately impresses one with the power of this muscle and what a large factor it can be, for better or for worse. In some instances, particularly of double cleft where the premaxilla has been forced too far back, this lip pull is sufficient to counteract orthodontic measures designed to bring the incisors forward. If the principle of lip pull is employed to reform the alveolar arch, it then becomes a matter of personal



A. *B.*

Fig. 9.—Complete unilateral palate and lip. *A*, Before operation; *B*, after closure by the use of lip pull.

choice as to the method and sequence of the operation by which this is accomplished. Many repair the lip as early as possible, later repairing the palate when the child is a year or so old, thus completing the case in two operations. However, it has been my experience that as good lips were not reconstructed and that frequently a secondary lip operation was necessary when the lip was repaired before the gap was closed, and further, the percentage of holes occurring in the extreme front part of the palate was greater. While of themselves these holes, if small, are not of such vital import, yet if they can be minimized it is advantageous. Before I used the principle of lip pull, it was the practice to repair the front part of the palate first and later, in six or eight weeks, to repair the lip. This has many advantages in that the front and difficult part of the palate is more easily closed before the alveolar border is molded, and furthermore is closed completely; which makes the closure of the posterior part of the palate much easier. Since using the lip pull the following sequence of operations has been followed which has proved very satisfactory: The front part of the palate is closed by utilizing a septal flap; the alveolus is molded to take the spring out of it;

the lip is then undermined and the edges at the top of the cleft are freshened down to the muscle and two silk worm sutures are then placed well back in the cheek so as to coapt the freshened muscle of the lip. (Figs. 10 and 11.) This almost reconstructs the nostril, though no attempt at complete lip repair is done. The baby is then allowed to rest for about eight weeks, at which time the lip has usually been converted into an incomplete cleft with the columella in the midline, the gap in the alveolus closed and the front part of the palate closed. This condition of affairs makes the repair of the lip at this time much easier, and a more satisfactory lip and nostril are reconstructed. (Fig. 12.) Later when the child is a year or so old the remaining part of the palate is repaired, which becomes often a comparatively simple procedure because the lip pull has further narrowed the cleft until it often lies almost in apposition. While this procedure has proved very satisfactory in my hands, it is in no way intended as a criticism of other sequences or methods of operation, for so long as the fundamental principles of any operation are adhered to, the details of technic must be somewhat a

Fig. 10. Fig. 11. Fig. 12.

Figs. 10, 11, and 12.—Unilateral lip and palate at the various stages of lip repair.

matter of individual experience so that a method is worked out which gives the best results; granting that another might get as good or better results by employing another way of accomplishing the same end. It might be asked why the lip and front part of the palate are not repaired at one time thus saving an operation; the answer is because it has been felt that this is a little more than some of these babies can safely stand.

To summarize: There are certain dental deformities which can be expected as a result of the cleft, chief of which are: displacement, absence, or poor development of the lateral incisor on the cleft side; also supernumerary teeth are more frequently found in cleft palate cases and in the families in which clefts occur. Following jaw penetration operations a larger percentage of missing teeth, misplaced teeth, and caries, is found than in those who have had no operation or have been operated by methods which do not penetrate the jaw.

In conclusion it is urged that much damage is done to the teeth and dental elements by penetration of the maxilla, which damage is largely elimi-

nated when some method which utilizes the principle of lip pull is employed. What method is used depends upon the individual preference of the operator, bearing in mind that the fundamental principles of any procedure must be sound if the end-results are to be uniformly those which are so earnestly desired.

DISCUSSION

Dr. Matthew N. Federspiel.—Dr. Kirkhams interesting paper deals with a problem that is of much concern to orthodontists who are treating malposition of teeth associated with cleft palate.

Because of the belief that cleft palate is caused by a failure of union of the lateral half of the maxilla and premaxilla, surgeons have in a large number of cases closed the gap by following the operating procedures known as the Brophy operation.

In many cases following such an operation, there was a loss of so many tooth buds that the maxilla remained stunted and failed to grow in proportion to the development and growth of the mandible.

Naturally, the forces of mastication and occlusion were either destroyed or in such a pronounced malrelation that the end-result was an extensive malocclusive and dentofacial deformity.

When one studies the embryologic development of the dentofacial area, one can appreciate that a failure of union of the various parts that make up the lip, the premaxillary bone, and the palate, will produce a cleft.

Arrested development to a large degree is a factor that prevents the union—especially true in a cleft of the alveolus between the ends and mesognathion. The cleft is due not only to a failure of union, but also to the mesognathion having failed to develop. In such cases there is always a lateral tooth missing. In some cases I have observed the endognathion and the mesognathion structures missing, leaving a large alveolar cleft. When this happens and the cleft is closed by forcing the lateral halves together, there naturally is an unharmonious relation of the maxillary and mandibular teeth. The mandibular arch is larger and the maxillary arch smaller.

If in such cases there is a loss of a number of tooth buds from passing wire through the alveolar structure, then the deformity is more extreme and the maxilla resembles an infantile jaw called maxillary micrognathia.

It is in such cases that the patient consults the orthodontist for relief.

Naturally such extreme dentofacial deformities with the loss of a number of maxillary teeth, have a rather unfavorable prognosis in so far as it relates to orthodontic care.

Therefore, I have for a number of years discouraged any operation that closes a cleft by forcing the parts together as performed in the Brophy operation.

Surgeons who manifest a desire to give their patients a well balanced facial outline should give serious consideration to the importance of preserving tissue in order not only to close the cleft, but to establish harmonious relation of the adjacent structure.

Surgery alone does not always offer to cleft palate patients the results hoped for. Orthodontics when mastered and its principles understood, offers to the oral surgeon a distinct advantage in the correction of complex and complicated malformation in cleft palate cases. Not only should the oral surgeon be familiar with orthodontics, but he should know the advantages that prosthetics offer in the field of oral surgery.

Many cleft palate cases that fail to respond to plastic surgery due to shortage of tissue, can be greatly improved with the insertion of artificial dentures and palates that give the patient a remarkable improvement which surgery alone fails to provide.

Therefore a knowledge of the principles and technic in surgery, combined with the principles and technic in orthodontics and prosthetics, gives the oral surgeon the judgment which is so necessary for the correction of palate and lip clefts, when complicated with dentofacial deformities, irregularities of the teeth, and malrelation of the dental arches.

I favor Dr. Kirkhams method of closing the lip early in life. The action of the orbiculary muscle will help mold the alveolar structures so that they conform to a better outline.

CASES COMPLICATED BY EXTRACTION*

By Stanley M. Dow, D.D.S., New York, N. Y.

I OFFER a plea for a better understanding between the general dentist and the orthodontist; not so much for a division of the responsibility to a patient, but rather for closer cooperation in the presentation of cases for treatment.

The two following cases were treated after the extraction of teeth.

In the first case extraction was considered advisable for economic reasons, in order to improve the appearance, and to give such orthodontic service as the patient could afford.

The patient was a girl, twenty-three years of age, presenting a Class I case with protruded and crowded maxillary and mandibular anterior teeth.

Fig. 1 shows the case before extraction of the maxillary right lateral and the mandibular right canine. The occlusion being locked, there was great disturbance of function, and an added handicap was the early loss of the maxillary and mandibular left first molars. The facial expression was distorted with protrusion and shortening of the upper lip and marked irritation of the lower right corner of the mouth and border of the lip because of the position and pressure of the canine tooth.

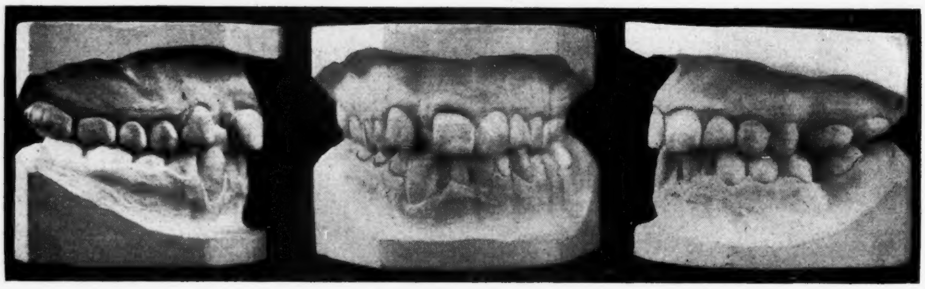


Fig. 1.

Treatment was begun six weeks after extraction of the teeth mentioned. No. 19 gauge maxillary and mandibular labial arches were installed. Loop springs were placed before the molar teeth contracting the maxillary arch, thereby bringing the maxillary right canine mesially and lingually to close the space made by the extraction of the lateral. In addition to the mandibular labial arch a coil spring was locked to an Angle ribbon arch band cemented on the mandibular right lateral, tipping the root bucally and distally forcing the tooth to occupy the space made by the extraction of the mandibular right canine.

Radiographs made by the dentist before treatment were requested numerous times, finally the dentist was informed that they had been lost. More recent radiographs show good condition of bone about the roots of all the teeth but also disclose an impacted maxillary left canine tooth in the palate.

*Read before the Dewey Alumni Society, October 29, 1930.

Fig. 2 shows the case after seven months of treatment with the anterior spaces entirely closed. The expression and appearance have been changed considerably and the masticating relation has been greatly improved.

If extraction could have been avoided, this case (Fig. 3) could have been treated to produce a perfect occlusion with the retention of all teeth.

Fig. 3 shows the case as presented. The patient was a girl twenty-one years of age with a Class I case with extreme crowding in the anterior region. The maxillary right lateral was locked lingually, with the maxillary right

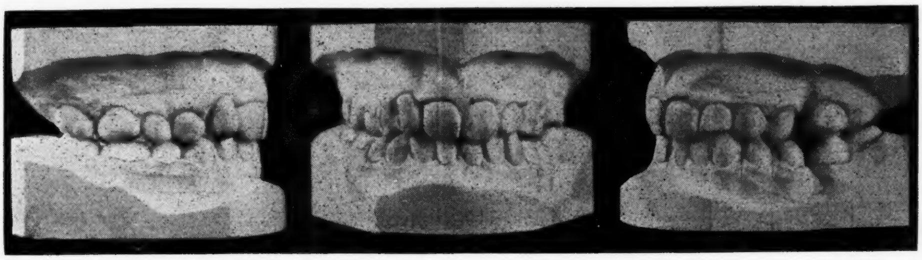


Fig. 2.

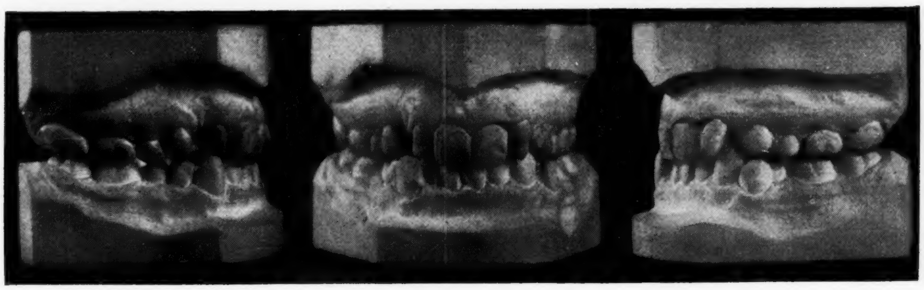


Fig. 3.

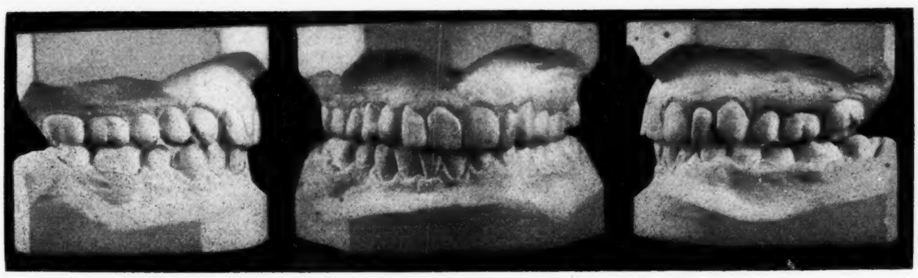


Fig. 4.

canine missing and the space reduced to about 2 mm. There was great irregularity of the occlusion, anterior to first molars on both sides, protrusion of the mandibular right canine, lingual position of the first and second mandibular right premolars. The four mandibular anterior teeth were forced to the right side, and the first and second maxillary premolars were practically on a line buccolingually. The maxillary left lateral was rotated 90 degrees with the lingual surface toward the median line. It was also tipped labially. The maxillary left canine was forced entirely out of occlusion and lying some distance lingually.

I was given a family history of a congenitally missing maxillary right canine tooth. Radiographs showed the tooth impacted and lying horizontally in the palate with the crown and lingual surface toward the median suture. The case was complicated by a very narrow arch and high vault. The patient was a mouth-breather with a slight nasal obstruction. The teeth extracted in this case were the maxillary left first premolar and the mandibular right first premolar. These teeth were extracted by a general dentist before the case was presented to me for orthodontic treatment.

Maxillary and mandibular labial arches were installed. Lingual appliances were used for expansion. The maxillary left lateral was banded, rotated, and brought into occlusion. Space was created for the maxillary right canine tooth, and upon exposure a pin was cemented into the canine. The canine was brought into position by spring force. The mandibular right canine and three anterior teeth were banded and moved bodily, thereby shifting the occlusion and closing the space created by extraction of the right first premolar. Intermaxillary elastics were worn to assist these different appliances. The length of time of treatment was about two and a half years.

Fig. 4 shows case after teeth had been in a passive state for six or eight months.

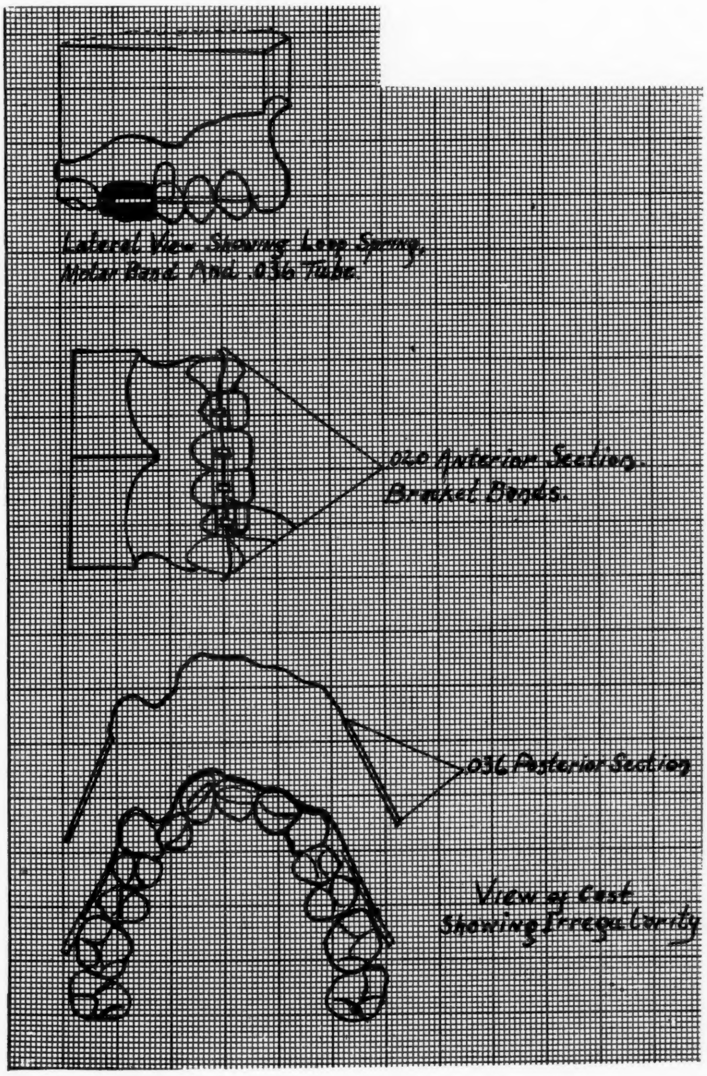
MODIFIED RIBBON ARCH APPLIANCE*

By Henry U. Barber, D.D.S., New York, N. Y.

THIS appliance as suggested by Dr. Hawley of Washington, D. C., consists of the following component parts:

A. The old or new type Angle bracket bands.

B. Molar bands with horizontal round buccal tubes attached.



*Clinic presented at the Thirtieth Annual Meeting of the American Society of Orthodontists, St. Louis, Mo., April 20-24, 1931.

C. Round anterior arch section which may vary in diameter from 0.018 to 0.022 (0.020 preferred), such wire terminating immediately posterior to the most distal bracket on either side of the mouth.

D. 0.036 posterior sections soldered to the free ends of the anterior section and extending back through the buccal tubes.

E. Loop springs attached mesially to the buccal tubes usually of 0.025 spring wire which may be arranged to move the anterior teeth mesially or distally—also with the proper anchorage the molars can be moved.

DEPARTMENT OF
ORAL SURGERY, ORAL PATHOLOGY AND SURGICAL ORTHODONTIA

DIAGNOSIS AND TREATMENT OF CHRONIC OSTEOMYELITIS OF THE MAXILLA INVOLVING THE MAXILLARY SINUS

By Sterling V. Mead, D.D.S., Washington, D. C.

(Continued from October issue.)

DIFFERENTIAL DIAGNOSIS

In the extensive cases of chronic osteomyelitis, especially those involving the entire maxillary alveolar structures, there is a very close resemblance to the picture presented by osteitis fibrosa. There is a difference of opinion among the members of the medical and dental professions as to the etiology and clinical picture presented by osteitis fibrosa. In making a differential diagnosis of chronic osteomyelitis, therefore, it is well to have in mind the possibility of an osteitis fibrosa.

In 1891 von Recklinghausen described a bone disease which has since been called osteitis fibrosa osteoplastica, osteitis fibrosa cystica, Recklinghausen's disease, osteodystrophia fibrosa, and neoplastic arthritis deformans. The generally accepted term at present seems to be osteitis fibrosa, with or without the appendage "cystica."

The disease was originally described as a "chronic bone disease with multiple tumors and cysts, accompanied by deformity and complicated by frequent fractures." In 1910 von Recklinghausen published an extensive pathologic study and suggested a classification of malacias. According to Hirsch, reviewing this report, "The characteristic of osteitis fibrosa is a fibrous tissue change in the medullary cavity, replacing the medullary content and producing absorption of the cortex from within outward. In osteitis fibrosa the activity of the resorptive process and the fibro-osteoid substitution is marked, and there is the formation of multiple tumorlike areas and cysts. The pathologic processes in Paget's disease (osteitis deformans) and von Recklinghausen's disease are fundamentally similar, especially in the earlier stages. The conditions have in common a disturbance of the equilibrium

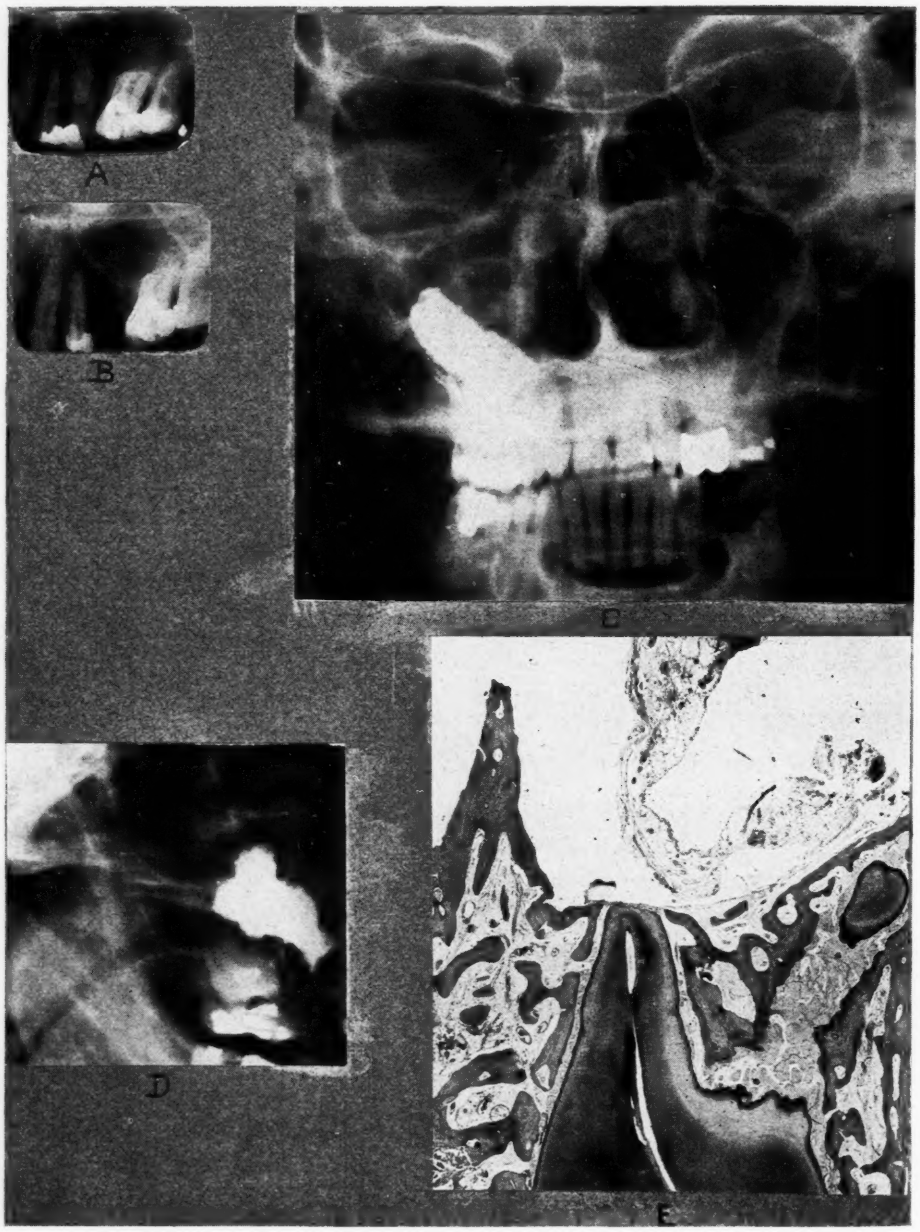


Fig. 14.—Case of Mr. C. *A,* Lateral intraoral roentgenogram showing premolar and molar teeth. There is no definite pathologic change shown in the bone. The teeth responded to the vitality test. This patient complained of vague, indefinite radiating pains in the region of the right maxillary sinus. Anteroposteror picture of the sinus, transillumination and irrigation of the sinus did not disclose any pathologic condition. On the patient's complaint, the right maxillary second premolar was removed An opening directly into a large cavity was found, which was thought to be a maxillary sinus, but upon further exploration, the cavity was found definitely to be walled off and separated from the sinus by a fibrous wall. This had no doubt been a cystic area that had degenerated into the chronic osteomyelitis type of the disease. *B,* Lateral intraoral roentgenogram after removal of premolar tooth. This chronic osteomyelitis involved both molar teeth and they were removed. *C,* Anteroposterior roentgenogram with lipiodol injected into the diseased bone cavity, showing its relationship to the maxillary sinus. It extends to the floor of the sinus. *D,* Lateral extraoral roentgenogram showing lipiodol injected and the relationship of the diseased cavity to the maxillary sinus. *E,* (x12) photomicrograph showing diseased bone tissue in the region of the right maxillary second molar. showing resorption of distobuccal root and the breaking down of the normal bone into an inflammatory type of tissue. Above the apices of the root is also shown the degenerated cystic tissue removed from the bone cavity.

which regulates the relation between the normal bone resorption and bone deposition. This and the marrow changes finally lead to malacia. . . . . The constant change is the softening produced by resorption and fibro-osteoid tissue substitution, with resulting deformity. The osteoid tissue in Paget's disease becomes calcified and the new bone formed in old and new trabeculae and under the periosteum produces the hyperplastic, hyperstatic changes with sclerosis and eburnation. In von Recklinghausen's type, the newly formed tissue partly degenerates forming cysts and recalcification and ossification is minimal."

From Hirsch's subsequent discussion of the subject it is noted that no sharp clinical or pathologic distinction can always be drawn between the two diseases; although, as a rule, Paget's disease is one of adult life, it runs a chronic course, spontaneous fracture is rare, and there is only a slight tendency to formation of tumors; whereas von Recklinghausen's is a disease of early life, running a self-limited course. Formation of cysts and tumorlike areas and spontaneous fracture are common. These two diseases really represent generalized forms of osteodystrophia fibrosa.

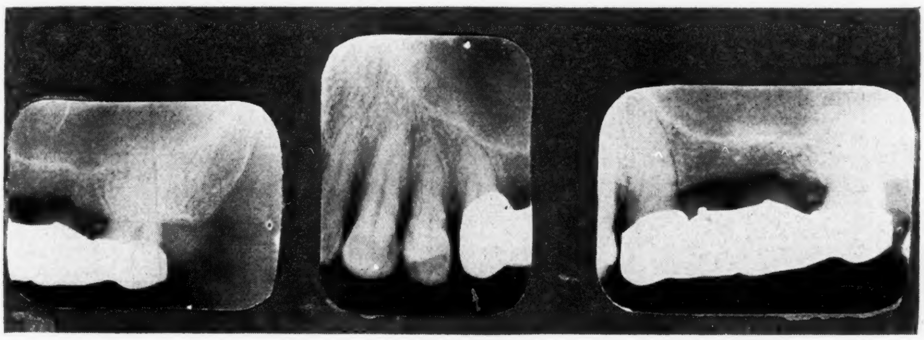


Fig. 15.—Intraoral roentgenograms showing region of right maxillary premolars and molars. In the maxillary second molar region is shown a definite bone change by an increase in the number of bone cells with a more or less regularity of size, and slight rarefaction especially of the ridge area. Pus was found in a small fistular opening in this region. An exploratory incision showed an area of chronic osteomyelitis extending into the maxillary sinus.

Becks and Weber in their study of the influence of diet on the bone system, especially with reference to the alveolar processes and the labyrinthine capsule, have shown that diseases of an organism can be produced by certain diet and therefore that certain bone diseases can also be experimentally produced. They described these chronic disturbances of metabolism as osteopathies (osteosis).

They further state that, "Diseases developing through calcium deficiency have always been of special interest and have been called in general 'Calciprivative osteopathies.' Research on rickets has shown that the Vitamin D content of the food is a deciding factor in the development of calciprivative osteopathies."

The pseudotumors in osteodystrophia fibrosa are known as "brown tumors." Siegmund has proved that the giant cell epulis (intraosseous epulis) is also such a "brown tumor." He emphasizes especially the fact that the so-called epulis represents the highest degree of an osteodystrophic process. This was also noted by von Recklinghausen.

Becks and Weber in their investigation found:

"1. In every case, the alveolar process was involved in the same sense as the general osseous system. In fact the changes in the bony part of the paradentium were more extensive than in the general bone system. This observation may be traced back to the traumatic influence of the occlusion, especially for the development of the brown tumors in the region of the jaws.

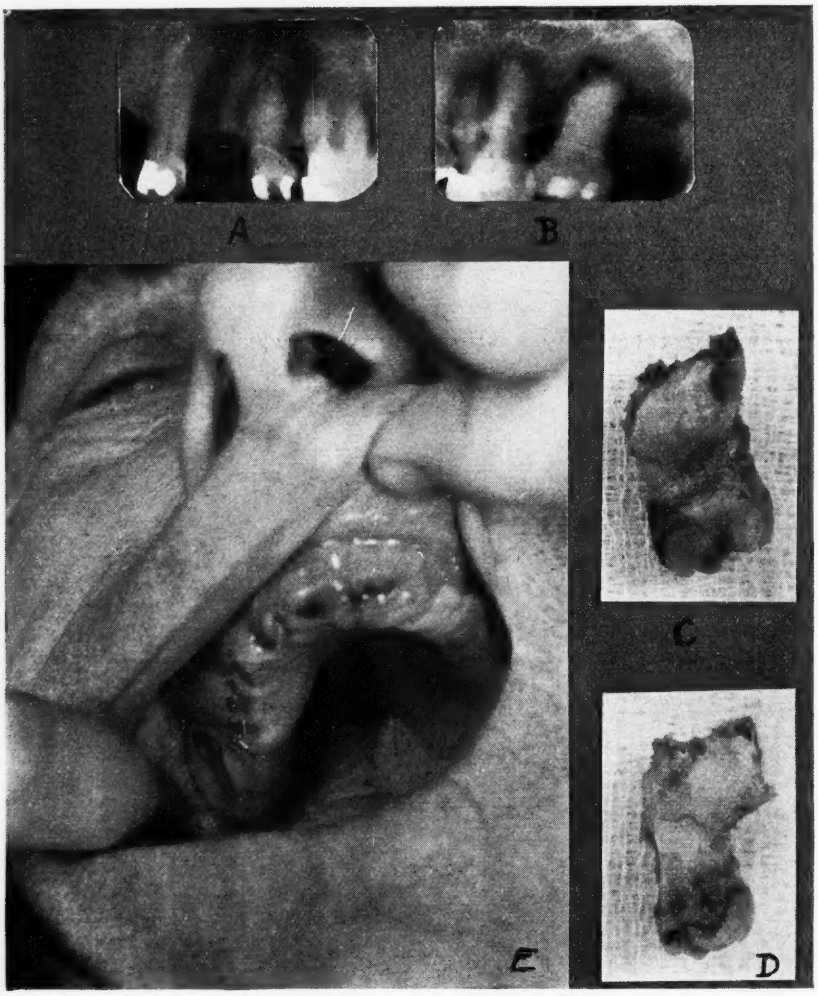


Fig. 16.—*A* and *B*, Lateral intraoral roentgenograms of right maxillary premolars and molars. The first premolar root shows questionable periapical bone condition. The second premolar does not show any definite pathologic change. The first and second molars show a deep periodontal osteitis and a questionably lessened density throughout the entire area, but there is no definite destruction of bone shown in the periapical areas. Upon operating this area, a definite chronic osteomyelitis was found extending from premolars to the tuberosity. *C* and *D*, Photographs of the molar teeth with the diseased chronic and inflammatory bone tissue attached to them. *E*, Photograph immediately after operation showing small opening in the last molar region left for the insertion of a wick and drainage.

"2. The labyrinthine capsule was changed in the same sense as the whole bone system and the alveolar process. As contrasted with the alveolar process, the changes in the labyrinthine capsule were not so marked as the general system.

"3. The influence of diet showed more markedly in the alveolar process than in the labyrinthine capsule.

"These changes must be referred to a chronic metabolic disturbance caused by an unbalanced diet. Three different forms of genuine paradentosis have been produced in dogs:

"1. a true osteoporotic form

"2. two osteodystrophic forms

a. a hypo-ostotic porotic form of osteodystrophia fibrosa

b. a hyperostotic porotic form of osteodystrophia fibrosa

"3. a scorbutic form."

In 1911 Silver published a review of the subject and listed the 97 cases on record in which only one cyst was present. None of these was in a flat bone.

In Morton's review of the literature in 1922, he made an exhaustive study of all cases reported to date, and the 63 cases of generalized osteitis fibrosa which he listed were the only ones he would accept as being true osteitis fibrosa, pointing out that there is a tendency to call any number of bone diseases an osteitis without sufficient information to diagnose them as anything in particular. This same tendency will undoubtedly be encountered in regard to the localized form.

In 1925 Sisk reported six new cases, one of which showed involvement of the jaw.

Galvin, in 1923, reported from California what he considered to be the first diagnosed and reported case of osteitis fibrosa in a flat bone, a definite case of osteitis fibrosa of the jaw due to trauma received two years previously.

In the same year Potts and Hatton recorded another such case, and since that time there have been several reports of similar cases from France and Germany.

The etiology of the disease is not yet understood. The earlier idea held by von Recklinghausen was that the process was basically inflammatory. At present Sisk and others regard trauma as properly considered a most important factor. Hirsch believes that osteitis fibrosa is congenital with strong hereditary tendencies and points out that parathyroid lesions are associated with bone changes and congenital hypoplasia might account for the disease. Knaggs in the Hunterian lecture for 1925 says that the exciting agent is a toxin of unknown origin.

There are conflicting views held, also, on the question of the relationship of osteitis fibrosa, osteitis deformans and osteomalacia; and of the relationship of this group to rickets. Knaggs considers that the group of three have the same essential characteristics and that any detectable difference is a matter of degree. Ude, two years later presents a case which he considers of especial interest, "in adding support to the correlation of osteitis fibrosa and osteitis deformans." On the other hand, Morton, Sisk and others believe that Paget's and von Recklinghausen's diseases should be sharply differentiated.

As to diagnosis and treatment: Sisk states that the x-ray picture al-

though not conclusive, is the most reliable aid to diagnosis and for treatment recommends conservative surgery as soon as the lesion is discovered.

It will seem therefore that it is very difficult to differentiate an osteitis fibrosa of the jaws from an extensive chronic osteomyelitis unless in addition to the osteitis fibrosa of the jaws there is a generalization of the disease with areas occurring in other bones.

(To be concluded in December.)

ORAL FOCAL INFECTIONS ROENTGENOLOGICALLY CONSIDERED*

By Louis J. Gelber, M.D., Elizabeth, N. J.

DENTAL AND ALVEOLAR TISSUES

DENTAL foci may exist either as a periapical abscess, a pericementitis, a granuloma or an interstitial gingivitis, both suppurative (Rigg's disease) and nonsuppurative. The infecting agent is usually a streptococcus belonging to the low virulence group, the *Streptococcus viridans.*

There is abundant clinical evidence to establish definitely the etiologic relation of dental infections to systemic diseases. Goadby, in 1912, reported three cases of arthritis deformans in which correction of the dental infection was followed by a subsidence of symptoms. Since then observers have emphasized dental foci as the source from which disease producing bacteria are disseminated throughout the body. Keyes' observations are especially interesting from the standpoint of the relation of dental foci of infection to body resistance against general infections. With the establishment of dental prophylaxis among children in an orphan asylum, the percentage of infectious diseases was reduced 59 per cent at the end of six months and to approximately 2 per cent during the following year.

Some of the infections caused by the teeth are:

1. Lymph-node infection.
2. Pulmonary focal infection.
3. Infection in the gastrointestinal tract, i.e., appendicitis.
4. Infections in the genitourinary tract.
5. Skin infections.

CYSTS

Cysts are fairly common in the jaw. There are two forms: root cyst and dentigerous cyst. The former arises perhaps most frequently from an old alveolar abscess. It appears as a large, rounded rarefaction in the jaw, usually attached to or partially enclosing one or more tooth roots and showing little or no evidence of trabeculation. It may be multiple. *Dentigerous* cysts have a similar appearance except that they develop from a buried tooth bud and generally contain teeth or portions of them. The bony structure of the jaws may be subject to any of the diseases which affect the rest of the skeleton. *Osteomyelitis* is fairly common and shows the same irregular destruction and proliferation seen elsewhere. A particular sort of osteomyelitis occurs with phosphorous poisoning; the bones become increased in density and thickness as a result of a new bone production which is followed later by suppuration and necrosis represented by irregular rarefaction. Syphilis occurs occasionally in the form of an irregular mottling of the bone due to extensive spotted rarefaction.

*Presented before the Union County Dental Society at Elizabeth, N. J., March 5, 1931.

TUMORS

Tumors of all sorts may be encountered—giant-cell tumor, and more malignant forms of carcinoma and hypernephroma. Their appearance is identical with that of similar growths in other flat bones. In addition, the jaw is the seat of a tumor peculiar to it, the odontoma, which is a dense mass made up of various tooth tissue and may be attached to a tooth or be composed of several teeth fused together. Sometimes they take the form of undefined masses of considerable density, which continue to grow, and develop into large deforming tumors. *Adamantinomas* are slowly growing masses which may or may not contain calcified material. They usually show multiple, irregular, small cysts within their structure. They expand the alveolar process carrying a thin bony shell ahead of them. The solid forms of the tumor are rare: they usually occur in the maxilla and average two to three years for their development. The much more common, cystic form generally appears in the mandible and may take ten to fifteen years to develop. These do not metastasize but they tend to implantation locally.

SALIVARY CALCULI

Salivary calculi must be mentioned in any consideration of the teeth. They cast a dense round or oval shadow seen in the position of the salivary glands or ducts. When projected upon the mandible in oblique views they must not be taken for areas of density in the bone. The shadows of calcified glands often appear in films taken of the teeth. They are spotted, mulberry-like shadows, characteristic of calcified glands anywhere. The tip of an unusually long styloid process may be projected upon the maxillary molar region and be mistaken for an extra tooth root, or a supernumerary tooth.

In adult teeth, the roentgen-ray examination is of value in demonstrating fractures below the gum level, and in determining the extent of carious processes, the position and extent of root canal fillings and the results of operative procedures. Pulp stones may be revealed in the pulp cavities. They are small, round, dense masses, frequently multiple, which form in the pulp chamber of one or more teeth. They have been thought to be the cause of severe neuralgias, but inasmuch as they are frequently seen without symptoms, their significance is questionable.

The most important pathologic conditions with which the roentgenologist has to deal are pyorrhea and alveolar abscesses.

PYORRHEA

Pyorrhea in its early stages gives little roentgen-ray evidence aside from a slight increase in the width of the dark line about the tooth, which represents the peridental membrane. As the infection continues and the alveolar process becomes involved, the bone retracts from the neck and finally from the roots of the teeth which are then kept in place only by fibrous tissue of the gums. As a rule, when the retraction of the alveolar process involves more than half the root, the tooth is doomed.

ALVEOLAR ABSCESS

Alveolar abscess in the acute stage, like osteomyelitis, gives no roentgen-ray evidence of its presence. Very shortly, however, rarefaction appears about the root involved, and at first the resulting dark area merges into the structure of the surrounding cancellous bone. The picture then becomes one of a definite dark sac attached usually about the apex root. This is the familiar form of alveolar abscess. Histologically most of them are found to be masses of granulation tissue containing a certain number of bacteria; less frequently there is a definite abscess cavity with a lining membrane. Erosion of the tip of the root extending into this cavity is often seen. In long standing cases, deposits of new bone laid down about the apex of the root produce bulbous enlargements which may wholly or in part fill the old abscess cavity.

The treatment of such an abscess depends entirely upon all the evidence, both medical and dental, which can be obtained. Not every tooth containing an alveolar abscess should be extracted, but each case should be treated upon its individual merits. Abscesses must not be confused with extensions of the antra downward, or pockets in the antra in the region of the maxillary premolars and molars, nor with the submental foramen which frequently overlies the apex of the mandibular premolar. Films of the maxillary incisors occasionally show the shadow of the nostril overlying a root which simulates an abscess. On the other hand, small abscesses arising from lateral margins of the root and overlapped by the image of the tooth may be entirely overlooked.

DEVELOPMENT AND ERUPTION

The root canals under normal conditions become increasingly narrower with advancing years. If, therefore, one finds in an elderly person an unusually wide pulp cavity and the root canal narrow, it means that in youth the pulp was for some reason (usually trauma) attacked by necrosis.

Total root absorption of the permanent teeth takes place occasionally.

In complaints of young people or adults in the region of the third molar, it is not enough to establish that the tooth is about to erupt. We have also to consider the direction of the tooth, because the pain is often due to pressure against the molar in front.

Sometimes a deciduous tooth is retained and the tooth to take its place never appears, and remains enclosed in the jaw in a varying stage of formation. The persistence of a single deciduous tooth can cause the permanent tooth to break through at other parts of the alveolar process, outside or inside.

Supernumerary teeth are rare. In rare instances a pair of teeth are found behind the maxillary incisors (gum teeth); if it be a single tooth, its crown is usually conical.

EARLY PATHOLOGY

A negative roentgen-ray finding in a tooth is no proof that the tooth is not infected.

The alveolar cancellous tissue around the roots is normally uniformly

dense and of regular meshy structure. Transparent parts of irregular form are usually due to pathologic processes of old standing.

If the apical alveoli of the two maxillary incisors are not visible, that can be normal. The cause is unknown.

Circular or oval transparent areas sharply delimited from the surrounding parts, and placed concentrically around a root that appears somewhat blunt, are always pathologic; root abscesses or granuloma. The transparency is not due to pus (which indeed is never visible), but to the spongiosa having been eroded or absorbed by the pus or the granulations. Root abscesses appear frequently in teeth that are apparently sound. If the transparent cavity is surrounded by a narrow dense sclerotic margin about 1 mm. thick, the granuloma or abscess has begun to heal or is already healed—an unusual contingency.

Teeth carrying extra strain, e.g., teeth used as bridgings or supplied with an artificial crown, may show a broadening of the whole peridental fissure and sclerosis of the surrounding compact bone of the alveolus. There are no signs of absorption in the peridental tissues or in the roots. Symptoms are usually absent.

In film negatives, which reach well beyond the roots of the teeth one sees 2 to 5 mm. above the roots large tongue-like or patchy uniformly clear areas, which could be mistaken for root abscesses in certain clinical conditions. The condition is not a pathologic one, but is due to extensions of the antrum of Highmore. The size of the clear areas, their regular form, and especially their thick limiting wall next to the alveolus indicate what they really are.

The communication of the dental roots with the maxillary antrum in cases of empyema of the antrum is easily distinguishable; on the other hand, it should be remembered that a root which appears on the film to project into the maxillary cavity may not project into it at all, but may be due to the focus, the tube being tilted too far obliquely upward. To decide whether a root is in the cavity or not, consider these points. A sound root appears enclosed by a narrow transparent line corresponding to the space occupied by the pericementum, then comes an opaque line which represents dense osseous substance of the alveolar wall. If both these limiting lines are intact, the apex of the root does not project into the antrum, when it is surrounded by a circular or oval clear space (granuloma or abscess).

An elevation on the floor of the antrum by the root of a tooth is sometimes found, especially in wide antral cavities.

The apex of a sound tooth is pointed or a little rounded and sharply delimited from its surroundings. Roots, therefore, that are found fringed or poor in calcium, are or have been diseased. The roots of many teeth that have been filled with stoppings are thus found.

Roots that have been broken off and lain in the jaw for years usually undergo marked atrophy and partial absorption. They, therefore, do not always show up in the roentgen picture as clearly as one might wish. We should be acquainted with this fact, in order not to make a mistaken diagnosis.

In injury and suspected fracture of a root do not miss the latter. If there has been no displacement of the fragments, the only sign of fracture is an oval line of light in the shadow of the root, as thin as a hair and just as recognizable.

In photographs of the two maxillary central incisors there usually appears a small very transparent spot between the roots, that to one seeing it for the first time looks like a fusion patch. This is, however, a perfectly normal picture of the incisor foramen. In an incorrect oblique projection, it can be projected into the root of a tooth and be then mistaken for a granuloma or root abscess.

The same holds for the mental foramen. It is situated in the mandible between the two premolars and below the ends of the roots.

A large apical foramen in a young and not fully formed tooth together with the loose connective tissue pad below or above it can be mistaken for a granuloma.

In many cases, the nasal bones and the nasal septum are projected also onto the film, occasionally even the malar bones. The possibility of these should always be reckoned with in estimating difficult and complicated views.

In patients complaining of earache, who are referred to the dentist when nothing is found wrong in the ears, the cause of the earache is almost always the mandibular teeth, even if the patient is of the opinion that it is the maxilla that is the trouble.

The roentgenologist who is not an odontologist should never neglect to make a close inspection of the pulp cavity and its degree of transparency. A frequent cause of trigeminal neuralgia is formation of dentin or complete calcification of the pulp. The beginner can quite easily overlook this. Old roots may also be productive of trigeminal neuralgia.

The various things to look for in x-ray plates of the teeth are:

1. Apical abscesses.
2. Absorption of apex.
3. Pericementitis.
4. Alveolar recession.
5. Dead tooth (vitality test).
6. Root-canal filling (imperfect or protruding).
7. Broach in canal.
8. Canal perforation.
9. Cavity (shell crown).
10. Root in antrum.
11. Retained root fragments.
12. Fracture of root.
13. Amputated root.
14. Unerupted tooth.
15. Impacted tooth.
16. Supernumerary tooth.
17. Bone whorl.
18. Bone cyst.

19. Bone tumors (benign and malignant).
20. Osteoperiostitis and osteomyelitis.
21. Necrosis.
22. Antrum empyema.
23. Soft tissue infiltration and swelling.

ABSTRACT OF
CURRENT LITERATURE

NUTRITION AND PEDIATRICS

BY SAMUEL ADAMS COHEN, M.D., NEW YORK CITY

It is the purpose of this JOURNAL to review so far as possible the most important literature as it appears in English and foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

Effects of the Lack of Vitamins on the Development of the Teeth. Makoto Shibata. Japanese J. Exper. Med. **9**: 1, 1931.

In the present paper Shibata evaluates the main points of his previous papers concerning his experimental studies upon the developmental changes in the teeth of albino rats and guinea pigs and their relationship to the partial lack of various nutritive substances.

Some of the significant conclusions of Shibata's researches are:

(a) The teeth of the albino rats lacking vitamin A show abnormal formation of the enamel, dentine and cementum.

(b) There is no recognizable histologic change in the teeth of the albino rats lacking vitamin D.

(c) The changes in the teeth of the guinea pigs lacking vitamin C are in concurrence with those changes which are commonly reported in scurvy.

(d) There is imperfect formation of the enamel in albino rats lacking in vitamin D in their diet, although these experimental animals show fewer disturbances in the formation of dentine matrix.

(e) On the masticating surfaces of the albino rat overfed with sugar there occurs dental caries (though Shibata admits there are no great histologic changes found in the teeth of guinea pigs).

(f) The main changes occurring in the teeth of the white rats lacking inorganic salts are the imperfect calcification of the dentine and the atrophy of enamel cells.

Shibata reports these experimental studies from the Second Pathological Department of the Government Institute for Infectious Diseases, Japan.

Manganese, Copper and Iron Content of Serving Portions of Common Foods. M. A. Hodges and W. H. Peterson. J. Am. Dietet. A. **7**: 1, 1931

The authors state that according to Rose the daily intake of manganese varies from 0.80 mg. for a child three to four years of age to 8.41 mg. for a working man. The same authority states that the daily intake of copper varies from 0.63 mg. for the young child to 4.81 mg. for the working man; iron from 4.5 mg. for the child to 36.12 mg. for the man. Hodges and Peterson state that foods richest in manganese are wheat bran, blueberries, whole-

wheat, split peas, beets, and navy beans Those foods which are richest in copper include calves liver, oysters, beef liver, mushrooms, currants and chocolate. Foods which are richest in iron are pork liver, beef liver, spinach, lima beans, calves liver, and navy beans.

Hodges and Peterson are of the opinion that (1) the rôle played by copper in formation of blood seems to be assuming greater importance; (2) to a lesser degree the same may be stated of manganese; (3) the value of iron is generally accepted as an indispensable element in nutrition.

Rate of Decalcification and the Sites of Bone Lesions in Experimental Hyperparathyroidism. H. L. Jaffe, A. Bodansky, and J. E. Blair. Proc. Soc. Exper. Biol. & Med. **28**: 8, 1931.

These investigators quote Bauer, Aub and Albright who found that in bone absorption, the calcium of the trabeculae is "labile" and is readily drawn upon, but the calcium of compact bone ("the structural part of the bone") becomes available only "in case of unusual body demand." As a result of their studies and animal experimentation at the Hospital for Joint Diseases, New York City, the authors add another conception to the above two, namely, "if we are to speak of labile calcium, it is the calcium in the regions of most active growth; if we are to speak of less readily available calcium, it is the calcium in the regions of less active growth." The added opinion was arrived at as a result of animal experiments with hyperparathyroidism.

These investigators are of the opinion that bone resorption and bone deposition are processes which go on in *all* bone constantly. When the rate of the processes is increased, it is increased in *all* bone. Both processes are more rapid in regions of active growth, irrespective of anatomic structure. As may be expected when there is rapid decalcification, it occurs to a greater extent in those regions which have more active growth. In the regions of less active bone growth, resorption and decalcification proceed more slowly under normal conditions, and these authors further state that a great stimulus is required to produce a considerable degree of resorption.

Behavior Problems in Children. M. J. Peterman. Wisconsin M. J. **30**: 6, 1931.

Peterman emphasizes the fact that although both the pediatrist and the general practitioner have not been keenly interested in the newer and ever increasing terminology in the behavior problems of the child, nevertheless they are and have been well acquainted with the modern trends of civilization and their effects on the child.

The behavior problem of childhood may be divided into two large groups: (a) the functional disturbances which manifest themselves with such outstanding symptoms as anorexia, temper spasm or tantrums, enuresis, tics and delinquency, (b) the second group of behavior problems arises from an organic basis and includes such pathologic lesions as cerebral injury, encephalitis and its residues, and the many varieties of demonstrative structural lesions in the brain.

This clinician states that sometimes only by a careful history is it possible to differentiate behavior problems which arise from an organic basis. Furthermore, Peterman quotes Lowrey, who states that the child is constantly experimenting with the whole environment, physical and dynamic, and uses various modes of behavior in order to find situations in which it is successful or in some way satisfying. And so at one time or another in their careers, all children lie, steal, have temper tantrums, refuse food and have many such manifestations of ill behavior. But whether or not the behavior will continue depends upon a complex of interacting factors, *the chief factors lying in the attitude of the adults and the satisfactions achieved by the child.* (Italics are the abstractor's.)

Naturally once the basis for disturbance is understood, the treatment which suggests itself is a readjustment or a change in the environment.

The Periodical Seasonal Incidence of Gastrointestinal Symptoms Complicating Respiratory Infections in Childhood: Seasonal Gastroenteritis. C. C. McLean. South. M. J. **24**: 7, 1931.

McLean emphasizes the seasonal incidence of gastrointestinal symptoms complicating respiratory infections in childhood The yearly percentage incidence covering an eight year period shows that from 51.6 to 95 per cent of these cases occur during the months of January and February.

The predominance of the gastrointestinal symptoms coupled with evidence of ketosis and prostrations frequently masks the precipitating cause of the condition, which according to McLean is respiratory infection. As a matter of statistics approximately 60 per cent of the children having this clinical entity had a respiratory infection or were just coming down with it or were just recovering from it. Sometimes although the child exhibited little or no symptoms of a respiratory infection, McLean noted that several members of the household were suffering from respiratory infection and the chances are that the gastrointestinal symptoms of the child were a clinical manifestation of a successful exposure to a ''cold.''

The gastrointestinal symptoms vary from mild to very severe and include nausea and vomiting, abdominal pain and in the more severe cases a classical picture of severe intestinal intoxication showing dehydration, sunken eyes, gray pallor, dry skin, cold extremities, drowsiness, and air hunger. Infants in particular and the younger children show the more severe clinical picture. Fever is often absent, and McLean found that constipation occurred more frequently than diarrhea.

The author mentions that this condition has been ably described in the literature by others, although not all seem to be in agreement of the specific cause of the clinical picture. For instance Marriott writes that the gastrointestinal symptoms are a specific intoxication due to a streptococcus toxin; others called this same symptom complex intestinal grippe or intestinal influenza.

However, there seems to be a general agreement that the seasonal gas-

troenteritis is a true ketosis. McLean quotes Philip Cohen who states that ketosis in children is either caused by starvation, that is, by a depletion of the carbohydrate reserve, or results from infection. The author further stresses the fact that the condition is a true ketosis and should be treated accordingly.

Experimental Rickets and Calcification of Dentin. H. Beck and W. B. Ryder. Arch. Path. **12:** 3, 1931.

Reporting their findings from the College of Dentistry and the George Williams Hooper Foundation for Medical Research, University of California, Beck and Ryder go into lengthy details concerning their observations on experimental rickets and calcification of dentin. These investigators studied the histologic changes of the maxillas and also of the mandibles of twenty-one rats who were placed on the so-called line diet (McColums 3143), a rachitic producing diet.

In their discussion of the literature concerning the formation of dentin, the authors summarize the present conception by stating that "the calcification of the ground substance of dentine most probably takes place through the dental tubules, or better through Tomes' processes." Moreover the function of the odontoblasts in the formation of dentin matrix consists in forming dental tubules and probably introduces the interfibrillar or cementing substance. However, the writers caution that definite proof of these points has thus far been lacking.

Beck and Ryder are of the opinion from their experimental studies with rachitic producing diets that the odontoblasts suffer severely in vitality to the extent that their activity gradually decreases until they are completely atrophied. In other words according to the authors there is a primary involvement of the odontoblasts. This being the case, it can be readily seen that any disturbance which occurs during the developmental period, as for instance in active rickets, leads to alterations in the formation of the matrix as well as in the calcification.

From their observation and experimental study Beck and Ryder conclude that the odontoblasts are the chief factors in the development of dentin and are required to produce the cementing substance which holds von Korff's fibers in place. Moreover the writers feel that the presence of odontoblasts is necessary to form Tomes' processes and so give nutrition and calcifying material to the dentin, and furthermore in order that calcium salts may be deposited and the matrix calcified.

The Occurrence of Perléche (Angular) Oral Infection in School Children and an Examination of Its Flora. F. Schwab. Dermat. Wchnschr. **92:** 1931.

Schwab reports his interesting observations of an infection of the angles of children's mouths, a condition which is seen comparatively often, particularly in children brought up in poorer hygienic surroundings. This entity, which is more commonly known as perléche, occurs much more frequently among children between the ages of eight and ten years.

In examining seventeen thousand school children in Nuremberg, Germany, Schwab found perlèche in 0.75 per cent. He mentions, however, that these figures are far below the 5 to 7 per cent average of other observers.

Excessive salivary secretion is rather common in children having these lesions. He states that at first the lesion appears at the junction of the skin and mucous membrane of the mouth. It begins as a grey thickening with a reddening of the skin. Later there are streaks of radiations from the angles of the mouth and soon the surface becomes excoriated and crusted.

Schwab feels that the lesion is slightly infectious, but he states that as yet there has been no definite etiologic factor proved. As a matter of fact any of the yeasts (fungi) or microorganism of the mouth may be present.

In the discussion of treatment Schwab mentions the application of silver nitrate solution or tincture of iodine as being of distinct aid. However, he states that prophylaxis is of far greater value, and this in the main consists of general cleanliness of the hands and face and the avoidance of rubbing or otherwise irritating the skin of the face and buccal mucous membrane.

Neurosis in Childhood. I. M. Allen. Brit. J. Child. Dis. **28**: 331, 1931.

Allen separates the causes of neurosis in childhood into two groups: (1) the factors which make the child less able to face his environment and difficulties; and (2) the factors which appear to excite the symptoms of a neurosis in the child at various stages in his development.

This London physician aptly points out that not only does some impairment, either physical or mental, lead to neurosis because it renders the individuals less able to face their environment, but often these children are handicapped only because their disability has led their elders, particularly the mothers, to protect them from experiences which otherwise would have been part of their normal training.

Fifty-one per cent of Allen's series of one hundred sixty-nine consecutive cases of neurosis in childhood were either the only child in the family or the youngest child. Other common factors which contribute to neurosis in the child include instances where there is father deprivation, either temporary or permanent. Often neurosis develops because of the increased attention which the child received during some illness or because of some period of continued ill health.

As an outstanding contributory etiologic factor in child neurosis, Allen particularly stresses lack of parental training in infancy and early childhood. The reference is especially apparent to the child who rules both the parents and household from the moment it is born. Generally this type of child develops behaviorism defects and shows a complete lack of discipline of every kind and often reacts to a new situation by the convenient development of a neurosis.

Sometimes even with a satisfactory background there are some children who develop neurosis because of some exciting causes. Among these may be mentioned the birth of the next child, particularly in those families where the child has been regarded for a long time as being the baby of the family. Sometimes school introduces the first serious attempt of the child to adapt

itself outside of its family circle and failure to adjust itself to school routine or school discipline frequently results in neurosis. Occasionally with older children particularly, increased school work or stress because of examinations causes neurosis. Puberty with its many complexes also may be mentioned as one of the contributing causes of neurosis even though children have what might be called a satisfactory background.

The clinical features of these children who have neurosis are characterized in about half of the instances by fear and apprehension. In over 25 per cent of the children there is what might be termed simple nervousness, and this is usually to be found when there is a tendency to avoid new experiences. Allen found that 43 per cent of the children of his series had tics or some such manifestation as shrugging of the shoulders, blinking, sniffling and the many facial grimaces. Only a comparatively small percentage of the children with neurosis clinically showed some actual disturbances of behavior or speech disturbances, enuresis or disturbances in sleep. In the writer's series 22 per cent of the children showed emotional disturbances in the form of peevishness, screaming attacks, outbursts of temper and other pet expressions of showing dissatisfaction at some disturbing factor.

Certain Phases of Nephrosclerosis in Childhood. A. Graeme Mitchell and George M. Guest. J. A. M. A. **97**: 15, 1931.

The authors comment on the fact that despite the great amount of work expended on clinical analysis, studies of pathologic changes, experimental investigations and discussions of nephritis, there remains much to be explained in regard to etiology, treatment, and unfortunately its prevention. Furthermore the authors rightly comment on the confusion which arises from the terminology indicative of renal involvement. The present paper deals with chronic interstitial nephritis or, as they term it, nephrosclerosis, the latter term better expressing the generalized involvement of kidney structure.

In regard to etiology of this condition, the authors found that there are a familial and an hereditary predisposition to it. Moreover they feel that intrauterine nephritis does occur or that there may be a chronic nephritis which has its beginning very early in life. Mitchell and Guest are of the opinion that recognizable focal infection does not occur with any greater frequency in children with chronic nephritis than in others who have no symptoms of kidney disease. They further state that "if high protein diets have an influence in chronic nephritis, this cause again does not appear to be clinically apparent in childhood."

The symptoms and examination of children with nephrosclerosis include such findings as marked retardation of growth, which is present in practically all such patients. Some of these children complain of polyuria and polydipsia. Loss of appetite may be a marked symptom. Headache and vomiting occur rather frequently, but such findings as edema and circulatory disturbances are very often absent. A fairly constant finding is the occurrence of anemia which is very often marked. According to the writers high blood pressure and cardiac enlargement are quite common in children with nephrosclerosis.

The urine is almost always of low specific gravity and has albumin and less frequently casts, white and red blood cells. Kidney function tests usually show marked renal insufficiency.

As is often noted in cases of renal rickets one of the outstanding features of this condition is evidence of faulty absorption and storage of calcium and phosphorus in the body. The authors bring up the important question of whether the same forces and agents which contribute to the causation of nephrosclerosis may not also interfere with the proper development and function of other organs and more particularly with the mechanism pertaining to the proper assimilation of food substances.

In discussion of this as well as of all other chronic and even acute diseases in childhood the authors emphasize the fact that the final problem is the effect these conditions have on the growth and future well-being of the individual. Therefore Mitchell and Guest are in agreement with many others when they state that the better treatment of this condition consists in planning for these children the diets to meet as far as possible their usual normal requirements.

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EDITORIAL

Educational Publicity

ABOUT eighteen months ago, a group of dentists in Little Rock, Ark., conceived the idea of trying to educate the public to appreciate the importance of dental service in relation to general health. These educational messages were carried in the local newspapers and contained such information as people should know in regard to the care of their teeth and oral health.

The messages were designed to reach the 60 per cent of the inhabitants of this country who do not avail themselves of dental service and who do not know the importance of oral health as related to general health.

As soon as the educational messages began to appear, two reactions occurred. The first was that various dental societies over the country began communicating with the Judicial Council of the American Dental Association as to whether such educational messages were ethical and were approved by the American Dental Association. The second was that various advertising agencies saw a new field opened up to them and consequently began making active campaigns for the purpose of inducing various local dental societies to employ educational messages in newspapers.

As a result it became apparent to the officers of the American Dental Association that they were confronted with a condition which had never existed before. The condition was that a large number of local societies, probably because of economic conditions, were favorably inclined to use educational messages. Also, various advertising agencies had become determined to sell these messages to the profession. Regardless of whether or not the officers of the American Dental Association believed in educational messages, it became necessary to devise some method whereby these educational messages could be controlled.

In consulting various advertising men and news agencies, the fact was brought out that if the American Dental Association did not adopt some plan whereby certain messages could be approved and others rejected, the public would be deluged with various types of educational messages, some of which would be good and some of which would be bad.

Such publications as *Printers' Ink* and *Selling and Buying* were consulted, as well as large advertising agencies, and all of them agreed that the only way to control the situation was for the American Dental Association to approve a series of articles. If this were done, virtually all advertising agencies would be compelled to use the messages which the American Dental Association approved. The approval of messages by the American Dental Association would give them such an advanced standing that no independent agency would be able to compete by using a message which was not approved.

Another side of the question was whether the campaign as conducted in Little Rock had produced results. A careful analysis of the situation revealed the fact that the dental profession in Little Rock had suffered less from economic depression than that in any other city of the same size and with similar conditions. This proved that the public was reading these educational messages and had come to appreciate the value of dental care as related to general health.

As a result of these various facts being presented before the Board of Trustees and the House of Delegates at the meeting of the American Dental Association in Memphis, an educational committee was established to function under the Bureau of Public Relations. The House of Delegates authorized the Board of Trustees to establish this committee, giving the committee the power to organize and function.

The first duty of the Educational Publicity Committee will be to approve educational messages which will be released for local dental societies to run in their local newspapers. These articles will be released only to societies which are component parts of the American Dental Association. They will not be released to individual men or unaffiliated groups.

The committee also plans to prepare a series of educational articles which will be released every week to the large daily and weekly newspapers to be run as educational news items. The committee will also endeavor to control radio broadcasting so that only the proper type of material will be released over the radio.

It is believed that this campaign of the American Dental Association will do much to educate the American public, especially the so-called 60 per cent who at the present time do not have dental care.

NEWS AND NOTES

Southern Society of Orthodontists

The twelfth annual meeting of the Southern Society of Orthodontists will be held at the Netherland Plaza Hotel, Cincinnati, Ohio, December 1, 2, and 3.

The program committee has in the process of development what promises to be one of the finest programs ever presented before the Society.

The meeting will be held in conjunction with the Ohio State Dental Society. All members of the American Dental Association and members of the various orthodontic societies are cordially invited.

W. J. FITZPATRICK, President.
OREN A. OLIVER, Secretary.

The Dental Society of the State of New York

The Dental Society of the State of New York will hold its sixty-fourth annual meeting May 11, 12, 13, 1932, at Hotel Ten Eyck, Albany, New York. A cordial invitation is extended to all members of state societies, Canadian societies and ethical dentists.

The officers and committees will present a program which we trust will enlist the attention of all dental practitioners.

Dr. E. J. Burkhart, 800 East Main Street, Rochester, N. Y., is Chairman of the Program Committee; Dr. E. W. Briggs, 1116 Madison Avenue, Albany, N. Y., Chairman of the Exhibits Committee; and Dr. E. Burley, 80 Fourth Street, Troy, N. Y., Chairman of the Clinics Committee.

For further information address the Secretary, Dr. A. P. Burkhart.

DR. A. P. BURKHART, Secretary,
57 E. Genesee St.,
Albany, N. Y.

Society for the Advancement of General Anesthesia in Dentistry

The next meeting of the Society for the Advancement of General Anesthesia in Dentistry will be held on Monday evening, December 14, at 7 o'clock at the Essex House, 160 W. 59th Street, New York City.

Elmer H. Brown, D.D.S., of Trenton, N. J., will give a talk on "The Psychic Approach to the Induction of a Smooth General Anesthesia." The discussion will be opened by T. Drysdale Buchanan, M.D., of New York City.

Membership in this society is open to all ethical practitioners in general dentistry or special practice, who agree to abide by every precept of the code of ethics of the American Dental Association. Meetings are held four times a year, in October, December, February,

and April in New York City. These meetings begin with a dinner at 7 o'clock, and the scientific session begins at 8 o'clock.

James Tayloe Gwathmey, M.D., Honorary President,
133 E. 58th Street, New York City.

M. Hillel Feldman, D.D.S., President,
730 Fifth Avenue, New York City.

Leonard S. Morvay, D.D.S., Secretary,
76 Clinton Avenue, Newark, N. J.

Sixty-Eighth Midwinter Meeting of the Chicago Dental Society

A score of committees are busily engaged completing plans to make the Sixty-eighth Annual Midwinter Meeting of the Chicago Dental Society the most successful in the history of the organization from every standpoint, including the scientific, exhibit and social angles. As last year, the meeting will be held in the Stevens Hotel, Chicago. It will last four days, from January 18 to 21, inclusive.

Expectations are for a general registration of 10,000 dentists, physicians, laboratory workers, dental assistants, and others.

In spite of the economic situation, a record number of exhibitors is expected, thus providing the visitors with complete displays of dental equipment and materials.

The scientific sessions will be divided into eight sections, as follows: operative dentistry; oral surgery and radiography; partial dentures, crown and bridge; mouth hygiene; full dentures; biologic sciences and research; orthodontia; and dental economics.

Leading men in the various fields of dentistry, from all parts of the United States, will present papers on the newest developments in all phases of dental science. These speakers will be supplemented by physicians who will discuss the topic of closer cooperation between medical and dental practitioners.

In effect, it is the plan of the society to make the meeting a four-day course of post-graduate work during which the research, experience and knowledge of outstanding authorities will be made available to those in attendance.

One of the most important events on the program deals with the various clinics. There will be two general clinics, one by the members of the Chicago Dental Society and the other by invited clinicians from all parts of the country. At the last meeting, the latter clinic had representation from thirty-five states. The two clinics will be held in the Grand Ballroom of the Hotel.

Table demonstrations by exhibitors will be held Monday morning—the opening day of the meeting. This feature was received with such enthusiasm at the last meeting that a larger hall will be made available at the coming meeting.

It is indicated that fully 125 firms will be represented in the huge exhibition hall, with elaborate displays of all improvements of a technical nature that contribute to the advancement of dentistry. The hall has 32,000 square feet of exhibition space and many of the exhibitors plan unusual and beautiful decorative schemes.

The social side will not be overlooked. Plans are being made for a number of events, including a midnight show in the Grand Ballroom; the annual banquet and dance; luncheon and bridge for the ladies at the hotel; a style show for ladies at one of the leading loop department stores; tours of the Chicago World's Fair site and buildings; visits to the huge Shedd Aquarium, the Field Museum, the Adler Planetarium, the Art Institute and other places; all of which are within a short distance of the Stevens Hotel.

The only credentials needed for participation in the meeting are membership cards in the American Dental Association or evidence of membership in a recognized foreign dental organization.

Alpha Omega Fraternity

The Alpha Omega Fraternity will hold its twenty-fourth annual convention December 25, 26, and 27, 1931, at the Statler Hotel, Buffalo, N. Y.

The first session will be held at 10 A.M. for registration. At 2 o'clock in the afternoon a trip to Niagara Falls has been planned; this will include dinner and dancing.

There will be three days of business and social meetings which will be held at the Statler Hotel.

Reservations should be sent to Dr. Jacob H. Greenberg, 490 Grant Street, Buffalo, N. Y.

Virginia—West Virginia Joint Meeting

The next annual meeting of the Virginia State Dental Association and the West Virginia State Dental Society will be held jointly at Winchester, Va., May 16, 17, 18, 1932.

Preliminary plans are well under way, and one of the largest and most interesting meetings ever held in the South Atlantic Section is predicted by the officers. Members of the American Dental Association are cordially invited to attend.

Dr. R. B. Snapp, General Chairman,
Winchester, Va.

Notes of Interest

Dr. David Houston and his associate, Dr. William A. Giblin, announce the removal of their office to 85 Park Street, Montclair, N. J. Practice limited to orthodontia and diagnosis.

Dr. Phelps J. Murphey announces the removal of his office from The Medical Arts Building to his new building designed for the practice of orthodontia exclusively, northeast corner of Fairmount and Welborn Streets, Dallas, Texas.